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NORTHEASTERN FOREST EXPERIMENT STATION

Amherst, Mass.

(Established 1923)

ANNUAL INVESTIGATIVE PROGRAM

1929

March 14, 1929

NORTHEASTERN FOREST EXPERIMENT STATION
OFFICE LIBRARY

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Northeastern Forest Experiment Station

Annual Investigative Program 1929

GENERAL

In the territory served by the Northeastern Forest Experiment Station, which comprises the New England states and New York and which has represented within its limits 5 forest regions, there are three methods of attack in investigative work. The first is to pursue a policy of short time investigations here and there over the several regions, the investigations undertaken being dictated by immediate needs and based largely on accumulated knowledge and experience; the second is to undertake a long time, well rounded program in one region and on the important timber types in that region; and the third, and most desirable, to carry on a combination of both.

The spruce and northern hardwoods region is a very important, if not the most important, forest region in New England and New York and one in which relatively little investigative work has been done. The mixed spruce and hardwoods stands in this region furnish the bulk of the pulpwood for the Northeast. The station already has major projects under way in mixed spruce and hardwoods and its efforts for some years to come should be largely concentrated on a complete study of such stands. This program should comprise study of the silviculture, management, economics, soils, ecology, physiology, fire protection, pathology, entomology and wild life relations. To undertake a program of this character means a minimum of 10 years of intensive work and probably double or triple that time before the more important problems are completely or partially solved, Results from such a program would come slowly at first and the station would seem to be accomplishing little. In the end, however, far more important results would be obtained than by scattering effort over all the forest regions within the territory of the station and dealing superficially with each. The other regions should be taken up in the same way when adequate provision could be made to do so. The station cannot attempt such a program on its present finances, since this would require additions to the present staff, of investigators qualified in soils, ecology, physiology, wild life and economics as well as additions to the type of personnel now with the station.

The foregoing program would lay the foundation for the practice of intensive forestry in stands of mixed spruce and hardwoods particularly, and for the spruce and northern hardwoods region as a whole. It would be some years in advance of actual practice, although probably not as far in advance of practice as it might seem now. One of the first studies forming part of this program would be the investigation of the yield of uneven aged mixed stands of spruce and hardwoods in which the development of volume tables for northern hardwoods would be a necessary step. At the same time other studies less basic in character but nevertheless of real value which could be largely completed in one to a few field seasons should be carried on. These studies should not be confined to any one forest region. At the present time the subject of girdling hardwoods to release spruce and balsam fir is a very active and important one to the forestry profession, but there is little available information on it. A detailed study of what has so far resulted would require one or two

field seasons to complete at the most but would yield valuable results of immediate application. Despite the large amount of planting that has been done throughout the teritory served by this station, there is very little fundamental knowledge on the subject. Plantations have succeeded, plantations have failed, the cause in one case remaining about as obscure as in the other. A study of plantations throughout the Northeast, some of which have been established for a good many years, would give information that could be immediately translated into practice and information that is rather acutely needed in view of the greatly increased program of reforestation which is imminent.

In case increased funds cannot be obtained for the station sufficient to handle both programs sketched above, decision will have to be made as to whether or not to pursue the policy of short time investigations which will yield results of immediate application rather than long time investigations concentrated in one forest region which will ultimately be much more valuable but which during their earlier years will be much slower in yielding tangible results.

The policy of concentrating work at more or less well defined centers instead of scattering it has been continued. These centers are Cherry Mountain and Waterville Valley in the White Mountain National Forest, New Hampshire, the Harvard Forest at Petersham and Mt. Toby Forest near Amherst, Massachusetts. As yet little work is under way on the two experimental forests of the station at Gale River near Twin Mountain and Bartlett, New Hampshire. However, 11 permanent sample plots were established on or immediately adjacent to the Gale River forest during the past summer.

BRANCH STATIONS

The station now has two experimental forests set aside for its use within the White Mountain National Forest in New Hampshire. One of these at Gale River, near Twin Mountain, consists of approximately 2700 acres with a diversified range of types and sites. The other, at Bartlett, comprises 5000 acres consisting largely of mixed hardwoods since the conifers have been cut out years ago. Topographic and type maps must be made on both of these forests so that the future work of the station can proceed in an orderly fashion, concentrating activities and establishing permanent work on these areas as far as possible and working elsewhere only if the desired locations cannot be found within the experimental forests. It may be possible to eliminate some acreage from either or both of the forests without affecting their value for experimental purposes. It is planned to begin mapping during the coming field season starting probably on the Gale River Forest and continuing until both forests are completed.

No new branch stations are planned for the immediate future, although eventually they may be established in central Vermont, northwestern Maine, the Adirondack region of New York, and the Allegheny hardwoods region of southwestern New York. Since a National Forest is to be established in Vermont within the next few years, it is probable that the station can select an area for its use there but since there are no National Forests in any of the other regions mentioned the proposed branches will have to be established through cooperation with state foresters, forest schools, lumbermen, or other agencies. For the present, the Mt. Toby Forest of the Massachusetts Agricultural College and the Harvard Forest will serve for the little work under way in the sprout hardwoods region.

In establishing branch stations it must not be lost sight of that if these are to be of value they must be developed intensively and such development will be costly. A branch station will require from $1,000 to $5,000 a year for its proper development and maintenance if activities are concentrated on it and the branch station fulfills its complete function. Consequently the station must proceed cautiously in the establishment and development of branch stations or it will find its resources committed to such an extent that routine investigations will be hampered or the branch stations will exist in name only. Both at Gale River and at Bartlett there will have to be a considerable building program in order to provide adequate quarters for the working force, and once a branch station is established and such buildings constructed a permanent and expensive liability has been set up. At Bartlett it will be possible to quarter the men in the nearby small towns. This could not be done advantageously at Gale River. The building program there will have to be more extensive providing living as well as working quarters. Each branch station, when work is under way, will practically require the full time of one man for its operation and maintenance, or else the technical force will be so harrassed by petty details having nothing to do with their actual investigations that their work will suffer severely.

Owing to the large timber sale now under way in the Waterville Valley on the White Mountain National Forest it will be necessary for the station to carry on considerable work in that locality for years to come, not only because certain things can be accomplished most effectively on a large timber sale, but because of the obligation that the station owes the administrative branch of the Forest Service in helping to solve silvicultural problems. However, this area is readily accessible by automobile both from Gale River and Bartlett in not to exceed 2½ hours time.

PERSONNEL

To function efficiently an experiment station must have a stable personnel The work of this station has suffered materially from a shifting personnel. The resignation of the former director was followed by an interval of some months before the new director was appointed on March 1, 1928.

In September Wheaton, who succeeded Behre, resigned to enter commercial work, after having been with the station about a year. He had charge of the sample plot work and would have made notable progress on the computation and analysis of these data during the current winter months. He would also have taken charge of mapping the two experimental forests during the coming field season. His successor has not yet been definitely selected since his resignation came at a time of the year when it is difficult to secure qualified men and the demand for well-trained men on the part of the growing experiment stations and the forest schools is such as to more than exhaust the supply of possible eligibles. Rose M. Delaney, assistant clerk, resigned in July. She had been with the station for several years and had charge of all the library indexing.

LIBRARY

Adequate library facilities are essential because any new investigative project must be preceded by a careful review of existing information bearing on it.

However, no attempt need be made to build up a complete forestry library for the station. It is planned to have the standard texts and reference books on forestry and allied subjects which are used regularly, supplemented by a good collection of technical pamphlets and several abstracting journals in forestry and biology in general. The main reliance for the research worker will be a card index which it is planned to make as complete as possible on technical forestry literature, indexing both material in the library and material which cannot be found there. In this way the investigator can quickly get at the literature of a subject and with the excellent library facilities of the Massachusetts Agricultural College, Yale University, and the Arnold Arboretum readily accessible to the station, and the large library at Washington so close that books can be ordered and received within 3 days or less, it would not be sound economy to establish a large forestry library here.

COOPERATION

The winter meeting of the Northeastern Forest Research Council was not held until May 1 in Springfield, Massachusetts and the summer meeting took place at the Yale Forest near Keene, New Hampshire on September 5. These meetings of the Research Council were particularly valuable to the new director in helping him evaluate the current projects of the station and possible future projects.

The value of having the station at the Massachusetts Agricultural College where research in other branches of agriculture and biology is carried on becomes increasingly apparent, the contacts with other investigators being valuable and stimulating. Since 1925 the station has given annually a course in forest ecology at the college. The course is open to seniors, graduate students and instructors, and consists of 30 lectures (3 lectures per week for 10 weeks). In brief it takes up (a) site factors, (b) reaction of forest vegetation to site factors, and (c) natural vegetative units of the United States, their classification and causes. The lectures are assigned to Mr. Stickel.

The 4 fire-weather stations are being continued through the financial assistance of the Harvard Forest, Maine Forest Service, Finch, Pruyn and Company, New York Conservation Department and the New York State College of Forestry.

Through the cooperation of the Anglo-Newfoundland Development Company it was possible to make observations on a number of large permanent sample plots established some years ago in spruce stands in Newfoundland to test various methods of slash disposal.

Cooperation with the Bureau of Plant Industry, the Bureau of Entomology and the Weather Bureau has continued to become more valuable to the station.

PROJECTS

There are now a total of 27 projects on the program, 12 major and 15 minor. On 5 major and 4 minor projects all the work is being done by cooperating agencies. Four minor projects are incidental in character and 3 major projects are either nearing completion or being reduced to such an extent that only a small amount of routine work will be required on them. No new projects are planned for the current year. The projects are distributed as follows:

	Major	Minor
Forestation	0	1
Management	2	6
Mensuration	2	3
Protection	7	4
Types	1	1
Total	12	15

1929 Minor Project

FORESTATION

Project

Source of seed -- Scotch pine (Fs-d-1).

Scope

To determine the relative desirability of stock raised from Austrian and Baltic Scotch pine seed for planting in the Northeast, the relative development of Scotch pine, red pine, and white pine in the same site; and the feasibility of underplanting Norway spruce for Christmas tree stock in mixture with pine.

Status

A Series of 4 plots on the Mount Toby State Demonstration Forest, Sunderland, Mass., each ½ acre in size, located in an old pasture, were planted in the spring of 1924 as follows: Plot 1, 2-year-old Baltic Scotch pines; Plot 2, 2-year-old Austrian Scotch pine, Plot 3, 2-1 red pine; Plot 4, 2-1 white pine. Trees were planted 6.6' × 6.6'. The west half of each plot was underplanted in Norway spruce, one spruce being planted in the center of each 6.6' × 6.6' square. Counts are made annually.

Results

Austrian Scotch pine so far shows the best development, followed by red pine, white pine, and Baltic Scotch pine. The underplanting of Norway spruce is doing particularly well in the Baltic-Scotch pine section of the plantation.

Progress for 1928

Counts were made in the spring of 1928. An examination in the fall showed that all species had put on excellent height growth.

Publications and Reports

None.

Plans

Plots will be examined again in the spring of 1929.

Assignment

M. Westveld, in cooperation with Massachusetts Conservation Commission and Massachusetts Agricultural College.

1929 Minor Project

MANAGEMENT

Project

Practice of forestry by private owners (M-1, WO).

Scope

To secure information as to the extent to which forestry is being practiced by private owners, the general character of the work being done, and the results secured; and to encourage the practice of private forestry by personal contact, addresses, correspondence, general publicity, publications and demonstrations.

Status

Because of unsettled market conditions the practice of forestry by private owners has not made the progress in New England and New York in the past few years that it should have. As can be seen from the following summary recent developments have been meager.

Connecticut

The New Haven Water Company, New Haven, in 1900 began work on its 12,000 acres on watersheds tributary to its reservoirs. Since 1908, management of the tract has been under the direction of Professor Hawley of the Yale School of Forestry. Planting and thinning have been the principal silvicultural operations practiced, with some final cuttings. About 2,000 acres have been planted, and the present nursery

capacity is sufficient to plant up about 200 acres a year. Thinnings, which begin in young timber as soon as the trees reach cordwood size and continue at intervals until the stand is old enough to be cut for lumber, have proved financially profitable.

Maine

The Bates College Forest of about 12,000 acres in southern Maine at Alfred has also been under intensive management for approximately 4 years. Silviculture, planting, brush disposal, and sustained yield are well exemplified, although it has so far not been possible to do as much experimental work as at the Harvard and Yale Forests.

The Great Northern Paper Company, Bangor, is another organization which has been considering thoroughly the possibility of applying more intensive methods of forest management on its holdings, but which has so far not made any extensive application of the information secured in modifying the usual methods of cutting. It is, however, still acquiring additional lands, with the evident intention of securing a property of sufficient size and adopting such methods of cutting as seem both practicable and essential to secure a sustained yield.

Massachusetts

The Harvard Forest at Petersham consists of some 2,000 acres of white pine, hemlock, and mixed hardwoods, and has now been under intensive forest management for about 20 years. This management involves the application of various silvicultural systems to secure natural reproduction, brush disposal, planting where desirable, and the management of the forest on a sustained yield basis. The forest is also used for a wide variety of investigations, some of them decidedly fundamental in character.

The E. Murdoch Company, Winchendon, has a forest property of 15,000 acres, chiefly pine lands, within hauling distance of its mill, which it is handling much more intensively than most forest areas within the region. Many of its logging operations involve partial cuttings with a view to securing natural reproduction, and thinnings have been attempted on a small scale. It has about 25,000 acres of softwood plantations and a large forest tree nursery with a present stock of probably 1,500,000 trees.

William Brown and Son, Winchendon, is another wooden ware concern which is handling its property in much the same way as the E. Murdoch Company, although the area involved comprises only a few thousand acres.

The New England Box Company, Greenfield, has about 30,000 acres of which it has an accurate timber inventory with information as to the age, rate of growth, and date of previous cuttings of its various tracts. Some silviculture is practiced in the way of partial cuttings and of thinnings in middle-aged stands, although clear-cutting is still the prevailing logging practice. A little planting has been done, and release cuttings made on some 600 acres.

George Beals, Winchendon, has gradually built up a forest property of 3,000 acres, chiefly of cut-over white pine lands, which he has been restoring to productivity by planting and weeding. Such cutting of merchantable timber as he does is also done carefully with a view to securing adequate natural reproduction. He is a rather conspicuous example of an individual who has started at the bottom with stripped lands with the fixed purpose of making them as fully productive as possible, both silviculturally and financially.

William H. Walker, Greenwich Village, has a sawmill which has been operating continuously on the same site for 100 years. Its timber supply has come chiefly, although not wholly, from a tract of 2,000 acres which has been conservatively handled by the Walker family during this entire period. A selective form of logging is used with the idea of favoring the young growth and of producing large trees of high quality. The method maintains the productivity of the land, some pieces of which have been cut over several times in the last hundred years.

New Hampshire

The Yale Forest of approximately 1,000 acres at Keene, is managed along much the same lines as the Harvard Forest, although it has not been under management so long. It is similarly used for both demonstration and experimental purposes, and the most intensive forestry possible is practiced in all cutting operations. Differences in soil of the two forests have led to more emphasis being placed on the production of pine at Keene than at Petersham.

The Brown Company at Berlin has a forestry department including one man who devotes his entire time to forest research. A large forest nursery is maintained the stock from which is, however, largely sold rather than planted by the company itself. The company has always been active in experimenting with different methods of cutting, brush disposal, planting, etc., but its large scale operations are along approximately the same lines as those of other concerns in the region. The company has recently set aside a tract of approximately 4,000 acres close to Berlin which is to be placed under forest management. This area has been cruised and mapped and a working plan for it is now being completed.

O. M. Pratt at Holderness has about 2,000 acres of pine and mixed hardwoods which he has been developing for the last 23 years. He, too, practices partial cuttings, which he is convinced pays financially. In addition, he has done considerable thinning and cleaning to promote the growth of overdense stands and to release white pine being held back by less valuable hardwoods. Perhaps the most distinctive feature of his forest management is pruning, which he has been doing rather extensively and most successfully for the last 20 years with highly gratifying financial returns.

The Dublin Associates formed in August, 1928 is a group of people who are creating a background to establish a consulting forester in that locality. The Associates have a membership of 53 and tracts of forest land controlled by the members aggregate 8,000 acres. This acreage is increasing steadily. The Forester operates the land of the Associates and any member or non-member may acquire the Forester's attention and the facilities of the organization. At present the work is largely mapping and organizing.

New York

Finch, Pruyn and Company, Glens Falls, have for 13 years been operating their forest properties on a sustained yield basis. Estimates made several years ago show a slight increase in growing stock. An attempt is made to encourage the development of young growth by partial cuttings wherever these are practicable and valueless hardwoods have been girdled on an extensive scale to release the understory of spruce and

balsam fir. The company employs two foresters who are constantly on the job. It is one of the few companies in New York state which gives every appearance of being seriously interested in continuous timber production.

The Whitney Preserve in the central Adirondacks is a large estate forest which was cut over in accordance with a plan prepared by the Forest Service which was one of the first working plans in this country. After a ten-year interval of no cutting, the lands are now ready to be cut over a second time for the same species as before.

The Racquette River Paper Company, Potsdam, has as yet done little along silvicultural or planting lines, but has recently made a careful estimate of its holdings and apparently now plans to handle these on a sustained yield basis with an annual cut of 10,000 cords per year, which it believes can be secured by natural regeneration.

The estate forest at Ne-ha-sa-ne Park was cut over under one of the early Forest Service working plans. In recent years more effort has been made to obtain close utilization and to prevent damage to young growth in logging operations than to practice silviculture or to secure a sustained yield.

Vermont

The Newton-Thompson Manufacturing Company at Forestdale is a well-known example of a concern which has been in continuous operation for many years. The company in its cutting operations makes a conscientious effort to favor the best trees and the best species, particularly paper birch, and counts on securing a continuous supply of timber adequate to its needs indefinitely from lands within easy hauling distance of its mill.

The Battell Forest of approximately 30,000 acres near Middlebury is handled on a sustained yield basis by a trained forestry personnel. This forest is the property of Middlebury College.

Progress for 1928

Facts were obtained on new developments and information by consultation furnished one large pulp company which is tentatively considering the practice of forestry on its holdings.

Publications and Reports

None

Plans

Data will be secured on new developments and assistance to private owners rendered as rapidly as work on other projects permits, and, as far as possible, in connection with them.

Assignment

Staff, Northeastern Forest Experiment Station.

MANAGEMENT

Project

Management of sprout hardwood stands (M-2).

Scope

To determine the best methods for cutting, reproduction, and subsequent handling of sprout hardwood stands in southern New England.

Status

Five permanent sample plots each 1/10 acre in size were established in 1924 in sprout hardwood land in the Simsbury State Forest, Connecticut. Three of these are on land recently burned, and 2 on adjacent unburned land. One burned plot and 1 unburned plot were thinned at the time of establishment. Sprouts were counted on the thinned plots in 1925 and cut so as to leave 1 or 2 of the strongest in each clump. On the other burned plots the sprouts were counted but no thinning was done. A careful inspection of the plots in 1928 revealed the fact that the cutting done by the choppers in 1927 had reached into the isolation strip surrounding 1 of the plots but had not reached the plot.

Results

Development so far indicate that scarlet oak sprout growth is usually more vigorous than white oak. Sprout growth on the burned plot is greater than on the unburned.

Progress for 1928

Plots examined in spring of 1928.

Publications and Reports

Typewritten progress reports.

Plans

Plots will be remeasured in 1929 and 1 plot reburned.

Assignment

M. Westveld, in cooperation with Connecticut State Forester.

MANAGEMENT

Project

Replacement of chestnut (M-3).

Scope

To determine the natural and artificial replacement of chestnut on blight-killed areas, and what species should be favored from the standpoint of silviculture.

Status

In June, 1924, 2 ¼-acre permanent sample plots were laid out on the Mount Toby Demonstration Forest, Sunderland, Mass. The plots were established on an area where blight-killed chestnut had been removed in 1919, and the area planted to 2-2 northern white pine. All trees and stumps were tagged. The height of all the pines was measured. For the chestnut, data were secured on the height and diameter of the stumps, average and maximum height of sprouts in each clump, and number of live and dead sprouts in each clump. In each plot a map was prepared showing the location of all tagged trees by numbers and species. In 1925, the plots were remeasured and permanent corner posts were put in. Beginning that year, the pines on one plot have been favored by cutting back all hardwood sprouts. The plots were remeasured and the hardwoods on the one plot weeded in 1926. During the 1927 remeasurement, a third plot, 1/10 acre in size was established in an adjacent stand where the dead chestnut is still standing. The third plot will serve as a check plot for the natural replacement of blight-killed chestnut.

Results

Thus far no analyses of the field data have been made. Both pine plots are restocking the areas entirely satisfactorily. On the weeded plot the pines are slightly taller and there are not as many suppressed trees as on the plot where no cutting back of hardwoods has been done. The unplanted plot is not restocking at all, and the area is growing up mostly to red and striped maple, with some black oak, eastern hemlock, and balsam fir.

Progress for 1928

All plots measured in fall of 1928. Field data brought up to date, and new maps prepared for the pine plots.

Publications and Reports

None.

Plans

Plots to be remeasured in 1929 and a progress report prepared of the growth on

the pine plots since 1924. The replacement of the chestnut on the pine plots is complete. Rather than abandon the plots it is planned to convert them into a problem of the management of northern white pine plantation. One plot will be held as a check. On the plot where the hardwoods have been cut back, such cultural operations as weeding, thinning, and improvement cuttings will be carried on.

Assignment

P. W. Stickel, in cooperation with the Massachusetts Agricultural College.

1929 Minor Project

MANAGEMENT

Project

Management of eastern hemlock (M-4).

Scope

To determine the best methods for cutting, reproduction, and subsequent handling of hemlock in both pure and mixed stands.

Status

Three ½ acre plots established in 1924. Hardwood canopy cut clear, releasing hemlock understory. Hardwood brush removed from half of each plot and left scattered on remainder. Red and white pine planted on two of the plots at rate of about 1000 per acre. One plot left unplanted as check. Hardwood sprouts over-topping pine or hemlock were cut back, and a re-tally of planted stock was made in the spring of 1926. A cumulative herbarium, showing succession of vegetation, has been kept with collections made in 1924, 1925, 1926, and 1928.

Work to date has been confined to a study of the development of a stand of planted red and white pines in an understory of hemlock, which has been released by clear-cutting hardwoods for fuelwood. Attention has been given to the following points:

(a) Recovery and rate of growth of hemlock of different sizes and in different positions.

(b) Effect of hemlock upon survival and development of inter-planted red and white pines.

(c) Severity of competition of hardwood sprouts with hemlock and pine.

(d) Influence of scattered hardwood brush.

(e) Succession of vegetation after removal of hardwoods.

Results

From remeasurements made in 1926 no correlation could be detected between death of planted pine and hemlock canopy. Competition of planted pine with vigorous hard wood sprouts has contributed to mortality of the pine. Mortality of the planted stock was higher among the plants of low initial vigor than among the more vigorous individuals. Hemlock has grown vigorously since the establishment of the plots, and no ill effects from removal of hardwood canopy are discernible. Surface vegetation has come in very rapidly on all the plots. Several significant changes in its composition have already been noted. The check plot has become an almost impenetrable thicket of hardwood sprouts, in which residual conifers of small size are making little growth.

Progress for 1928

No work was done on this project in 1928, except to collect and list the vegetation for the cumulative herbarium.

Publications and Reports

None.

Plans

Another cleaning of hardwood sprouts should be made in spring of 1929 before growth starts. A complete remeasurement of both residual hemlocks and planted pine should be made in spring of 1929, as five years of growth have now been completed. Plots should be maintained as continuing project indefinitely.

Assignment

_____.

1929 Minor Project

MANAGEMENT

Project

Permanent sample plots (M-5).

Scope

To maintain the permanent sample plots which are under the jurisdiction of the Northeastern Forest Experiment Station.

Status

A total of 169 permanent sample plots comprising approximately 75 acres are now handled by this station as is shown by the following table:

Permanent Sample Plots - January 1, 1929

Total number 169. Total area 74.13 acres

Serial plot number	Locality	Object	Acreage	Establishment	Examination	Remeasurement
		Connecticut				
1-2	Near Union	Reproduction in white pine after clear cutting.	1.00	Oct. 1906	Every 5 years	May 1930
3-4	Near Farmington	Thinning in mixed hardwoods.	.58	Sept. 1906	Every 5 years	May 1930
5-10	Near Farmington	Thinning in mixed hardwood coppice.	1.65	Oct. 1906	Every 5 years	May 1930
11-16	Near Windham	Thinning in mixed hardwood coppice.	.80	Oct. 1906	Every 5 years	May 1930
17-19	Near Windham	Reproduction cuttings in severely culled mixed hardwoods	1.50	Nov. 1906	Every 5 years	May 1930
20-24	Near Windham	Thinning in mixed hardwood coppice.	1.25	Nov. 1906	Every 5 years	May 1930
25-29	Near Simsbury	Effect of burning in mixed sprout hardwoods	.50	May 1924	Every 5 years	May 1929
		New Hampshire				
1-6	Corbin Park	Thinning in even-aged spruce.	3.00	Oct. 1904	Every 5 years	May 1930
7-9	Corbin Park	Development of spruce under hardwoods	1.50	Sept. 1905	Every 5 years	May 1930
10-11	Corbin Park	Thinning in Northern white pine	1.00	Sept. 1905	Every 5 years	May 1930

Serial plot number	Locality	Object	Acreage	Establish-ment	Examina-tion	Remeas-urement
20-21	Corbin Park	Thinning of even-aged red spruce.	.40	July 1906	Every 5 years	May 1930
22-25	Near Water-ville	Reproduction after logging in spruce and hardwoods.	2.00	June 1906	Every 5 years	Oct. 1931
29-32	Near Peter-boro	Development of old field Northern white pine.	1.30	July 1906	Every 5 years	May 1930
33-38	Near Peter-boro	Development of planted Northern white pine.	1.85	July 1906	Every 5 years	May 1930
39-44	Near Peter-boro	Thinning in Northern white pine.	1.28	July 1906	Every 5 years	May 1930
45-48	Near Peter-boro	Thinning in mixed pine and hardwoods	1.20	July 1906	Every 5 years	May 1930
49-50	Near Peter-boro	Transplanting in old field pine.	.40	July 1906	Every 5 years	May 1930
51-55, 58	Near Man-chester	Growth of planted and natural Northern white pine	1.42	Aug. 1906	Every 5 years	May 1930
59-62	Cherry Mountain	Methods of cutting in spruce and hardwoods.	2.00	Sept. 1924	Annu-ally	1929
63-67	Cherry Mountain	Slash disposal methods in spruce and hardwoods	19.20	Oct. 1925	Annu-ally	1929
68-71	Cherry Mountain	Weeding in spruce and hardwoods.	1.00	Oct. 1927	Annu-ally	1929
72-74	Waterville	Weeding in spruce and hardwoods.	.75	Oct. 1928	Anua-ally	1929
75-77	Waterville	Slash disposal methods in spruce and hardwoods.	6.00	Oct. 1928	Annu-ally	1929
78-80	Johnson Brook	Slash disposal methods in spruce and hardwoods.	6.00	Oct. 1928	Annu-ally	1929
81-85	Gale Riv-er Forest	Growth and development of even aged spruce-fir.	1.05	June 1928	Every 5 years	1933

Serial plot number	Locality	Object	Acreage	Establish-ment	Examina-tion	Remeas-urement
86-87	Gale River Forest	Growth and development of black spruce.	.20	June & July 1928	Every 5 years	1933
88-89	Gale River Forest	Growth and development of even-aged spruce-fir.	.35	July 1928	Every 5 years.	1933
90	Gale River Forest	Growth and development of spruce and hardwoods.	.30	Aug. 1928	Every 5 years.	1933
91	Gale River Forest	Growth and development of black spruce.	.13	Sept. 1928	Every 5 years.	1933
92-93	Waterville	Methods of cutting in spruce and hardwoods	1.00	Aug. 1928	Annu-ally.	1929
		Vermont				
1-5	Pomfret	Thinning in second growth hardwoods.	.50	Aug. 1904	Every 10 years	May 1935
6-11	Sharon	Increment in northern hardwoods and hemlock.	3.00	Sept. 1904	Every 10 years	May 1935
12-18	Sherburne	Methods of cutting in spruce and hardwoods.	1.15	1906	Every 5 years	Sept. 1932
19-22	West Roch-ester	Methods of cutting in spruce and hardwoods	.85	Aug. 1906	Every 5 years	May 1930
23-24	West Roch-ester	Thinning in evenaged mixed hardwoods	.32	Aug. 1906	Every 5 years	May 1930
25-27	Plainfield	Slash disposal in old field spruce.	.75	Aug. 1927	Every 2-5 years.	1929
28-29	Battell Forest	Methods of cutting in spruce and hardwoods.	1.00	Sept. 1927	Every 5 years.	1932
30-34	Battell Forest	Growth and development of old field spruce.	1.10	Sept. 1927	Every 5 years.	1932
35-37	Battell Forest	Weeding in spruce and hardwoods.	1.50	Sept. 1927	Every 2-5 years.	1929

Serial Plot number	Locality	Object	Acreage	Establish-ment	Examina-tion	Remeas-urement
		Massachusetts				
1-2	Mt. Toby Forest	Growth of Scotch pine plantation.	1.00	Spring 1924	Every year.	1929
3	Mt. Toby Forest	Growth of Norway pine plantation	.50	Spring 1924	Every year.	1929
4	Mt. Toby Forest	Growth of white pine plantation.	.50	Spring 1924	Every year.	1929
5-7	Mt. Toby Forest	Planted white pine under hemlock and hardwoods.	.75	Spring 1924	Every year.	1929
8-9	Mt. Toby Forest	Planted white pine following chestnut	.50	June 1924	Every year.	Oct. 1929
10	Mt. Toby Forest	Natural reproduction following chestnut.	.10	June 1924	Every year.	Oct. 1929

Sixty three of these plots have been established by the station and the remainder were previously established by the Forest Service and turned over to the station. The plots established by the station have been in connection with definite projects and some of the previously established plots are now proving valuable for current projects. Since the permanent sample plots demand long time study, since many may be worth while continuing after the original purpose of their establishment has been fulfilled, since it is apparent that some plots may furnish information for projects other than those for which they were originally intended, (plots established for study of methods of cutting and other purposes are now being used on the bronze birch borer project), and since it is very valuable to have a complete summary of such plots to avoid establishment of too many plots which become permanent liabilities, it is desirable to treat these permanent plots as a separate project.

The situation now has a large number of permanent plots, possibly too many, so that conservatism must be observed in the establishment of additional ones, It may be that some of the old plots can be dropped, but this should not be done until after the next remeasurement or at least until a careful field examination has been made and the accumulated data carefully analyzed. It must be remembered that invaluable and accurate information obtainable in no other way is furnished by permanent sample plots and these must be established years in advance to anticipate future needs. What may be too many plots now for the resources of the station, may be far too few 5 or 10 years hence when resources and demands have greatly increased. For example, methods of cutting plots established in mixed spruce and hardwood stands

may be used for study of yield in this type and additional plots needed, if no satisfactory method can be developed for determining yields in uneven-aged mixed stands. In any event some plots will be necessary for a check on yields in these stands.

Results

The compilation work on 2 sets of the series of permanent sample plots established by the Forest Service in 1905 and 1906 has been completed. One set consisting of 4 ½-acre plots located near Waterville, New Hampshire, in mixed spruce and hardwoods was established to study the development of spruce stands following cutting. The more important facts brought out by these plots follow: (1)Heaviest mortality occurred on the plot which contained the highest volume of reserve spruce, the loss amounting to 7.6 cords per acre over a period of 20 years, or more than a third of a cord per year. (2) The highest net increment was recorded on the 2 plots which contained the least residual volume of spruce, 1 plot producing approximately 3 cords per acre in a period of 20 years and the second plot 2 cords. (3) Conditions indicate, however, that the plot which showed the heavy mortality of 7.6 cords will, after the bulk of the reserve stand has died or windthrown, show the highest net gain due to the excellent growth on the coniferous reproduction which has only a small volume of hardwoods to compete with. The volume of wood put on by the reproduction alone at the end of 20 years amounted to 5.5 cords. (4) The experiment indicates that under conditions represented by the plots, in order to avoid heavy losses from windfall and register early net increments, spruce and fir should be cut to a low diameter limit and hardwoods should be removed to permit the proper development of the young coniferous stand.

The second experiment consists of 3 ½-acre plots located at Corbin Park, New Hampshire in a hardwood stand containing a dense understory of spruce reproduction to show the effect of girdling hardwoods on the development of the young spruce stand, 1 plot being heavily girdled, the second moderately girdled, and the third held as a control. The results of the experiment may be summarized as follows: (1) At the end of a 22-year period the heavily girdled plot produced at the rate of 900 cubic feet or 10 cords of spruce wood per acre, the moderately girdled plot 565 cubic feet of 6.3 cords, and the ungirdled plot 158 cubic feet or 1.7 cords. (2) On the heavily girdled plot volume growth was over 5 times and on the moderately girdled plot 3 times as rapid as on the ungirdled plot. (3) Periodic annual growth on the heavily girdled plot increased from ¼ cord during the period 1905 to 1920 to 1 cord per acre per year for the period 1925 to 1927, while during the same periods the moderately girdled plot rose from 1/6 cord to ½ cord per acre per year. The ungirdled plot today is producing less than 1/10 cord per acre per year. (4) It is possible through girdling to convert a young merchantable hardwood stand containing an understory of spruce into a pure coniferous stand.

Progress for 1928

The Research Council at its meeting in May 1928 recommended that the computation and analysis of sample plot data already accumulated be pushed. Owing to losses in personnel, not as much was accomplished on this as had been hoped for, but considerable progress has been made. A complete card index of the plots by states, by projects and by number has been prepared which greatly facilitates handling the

records. The old records, some of which were in poor shape, have been largely transferred to new forms of standard size and all the information of any one plot brought together. This work is still under way.

The data on 4 plots at Waterville, New Hampshire (Nos. 22-25) and 3 plots at Corbin Park, New Hampshire (Nos. 7-9) have been analyzed and the analysis is discussed under "Results". The analysis of the data on 7 plots at Sherburne, Vermont (Nos. 12-18) is nearing completion. These results are directly applicable to the project "Methods of cutting and reproduction in spruce types (Mc-1)", the information on girdling hardwoods to release spruce being particularly timely and valuable.

Eleven plots were established on or immediately adjacent to the Gale River Forest near Twin Mountain, New Hampshire for the project "Growth and yield of spruce and balsam fir (ME-2)". On these plots the station pathologist took detailed notes on the condition of individual trees and it is planned to have the station entomologist study the insect conditions. In or close to Waterville Valley, New Hampshire 12 plots were established for projects "Methods of cutting and reproduction in spruce types (Mc-1)", and "Slash disposal (Mb-1)".

Publications and Reports

Westveld, M.: The establishment of permanent sample plots for study of methods of cutting. Mimeographed, 23 pp. 1926.

Westveld, M.: Results of the hardwood girdling experiment at Corbin Park, New Hampshire. Typewritten, 8 pp. January, 1929.

A summary of permanent sample plots by all agencies in the region. Mimeographed, 40 pp. 1927.

Plans

Proceed with transferring old records to new forms and with the computation and analysis of data on additional old plots if possible. Locate and remeasure old reproduction plots in Waterville Valley. No new permanent plots will be established with the possible exception of 2 groups of 3 each for slash disposal on certain aspects of slope not now represented, only if logging operations necessitate and a series of 4 weeding plots in cut-over mixed spruce and hardwoods.

Assignment

_____ and staff, Northeastern Forest Experiment Station.

MANAGEMENT

Project

Slash disposal (Mb-1).

Scope

To determine (a) the relation of slash of various species to protection of forests from fire, disease, and insects; and (b) the desirability of various methods of slash disposal.

Status

In 1925 a study of the rate of disintegration of white pine slash was started in cooperation with the Harvard Forest. A resume of the results of this work is to be published as a bulletin of the Harvard Forest. A detailed account of the work will appear as a technical bulletin of the United States Department of Agriculture. Two phases of the white pine slash study are still being continued on the Harvard Forest, a study of the influence of insects in promoting decay and a study of humidity and temperature in the upper and lower parts of piles of white pine slash.

A study of the hardwood slash problem was also begun in 1925. Examination of slash on various aged cuttings in mixed spruce and hardwoods have been supplemented by more intensive studies on several permanent sample plots which have been established in the White Mountains of New Hampshire. The first set of 2 plots each 4.2 acres in size was established in 1925. On 1 plot both hardwood and softwood slash was lopped; on the second no slash disposal was practiced. In 1926, 3 more plots each 3.6 acres in area were established. The same types of slash disposal were practiced as in the first series and in addition the method of burning softwood slash and leaving hardwood tops intact was practiced. Maps made of the plots show location of skid roads and trails, stumps, residual trees, and slash piles and also the character of slash with respect to height, density, and species of which composed. Tallies of reproduction on milacre transects were also made and observations on slash deterioration were made at intervals.

In connection with the above studies of slash decay about 2500 specimens of wood rotting fungi have been collected, identified, and filed with proper records which will make them valuable in future problems connected with the dacay of wood.

Results

Two general extreme conditions have been found to govern the rate of decay of slash. These are quick and excessive seasoning and water logging. Studies so far indicate that: (1) Soil with moisture favorable for good corn or potato growth is favorable for rapid decay of slash. (2) On warm slopes slash may dry out promptly and resist decay while on cold ones, it may become water logged and resist decay

equally long. Yellow birch is particularly prone to water-logging and for this reason should not be lopped. (3) Ranked in the order of durability of slash, chestnut ranks first, followed by oak, ash, yellow birch, maple, beech, basswood, paper birch, poplar and aspen. (4) There is a decided variation in the action of lopping in different situations, and the effect of lopping varies with the species somewhat as does the durability of wood of that species. (5) In general, lopping can hasten the rate of decay of the less durable woods very little; so little in fact that its cost is not justified. Such species are aspen, poplar, paper birch and basswood. Lopping of maple and beech depends upon local conditions but usually yields too little results to justify the extra expense. Yellow birch, because of its extreme readiness to water log, hardly ever should be lopped. Ash, chestnut and oak in most situations will give maximum results from lopping.

Intensive mapping and study of one set of permanent plots revealed the following facts: (1) Thirty-nine per cent of the area was covered with slash; (2) classifying slash on the basis of density, 18% of each area was covered with dense slash, 11% with medium, and 10% with light. (3) Dense softwood slash not only crushes and kills the advance reproduction beneath it, but effectially prevents the establishment of new reproduction on all areas occupied by it for a period of from 15 to 20 years. (4) Hardwood slash rarely hinders reproduction seriously for more than 5 or 6 years. (5) Unlopped hardwood tops, because of their open character, permit a certain number of seedlings to push their way through without undue interference. Lopping hardwood tops increases the chances for smothering seedlings. Lopping softwood tops does not improve conditions for present or incoming seedlings.

Progress for 1928

But little has been done on extensive reconnaisance owing to pressure of other problems. Two sets of 3 plots each, representing different exposures, were established in 1928, on the White Mountain National Forest. Each plot is 2 acres in size. On each set a duplication of the methods of slash disposal followed in 1926 was made. The project now is settling down to a basis of study of permanent plots. Those first established in 1925 are beginning to decay appreciably.

Two weeks were spent visiting the experimental cutting plots of the Anglo-Newfoundland Development Company on Harpoon Brook, Newfoundland, and in examining slash and collecting wood rotting fungi at Spruce Brook, Newfoundland. About 100 collections were made. General conditions at the places visited were much like the upper spruce slopes in the White Mountains. The fungi were the same and the rate of decay equally slow.

Publications and Reports

Spaulding, Perley. References to literature on slash disposal as they bear upon Northeastern conditions, with brief abstracts. Mimeographed, 16 pp. November, 1925.

Spaulding, Perley. The role of fungi in the disposal of slash. Forestry Protection Conference at Syracuse, New York, November 12, 1926, pp. 11-13.

Spaulding, Perley. The decay of slash of northern white pine in southern New England. To be published as a United States Department of Agriculture technical bulletin. Typewritten, 47 pp. 1928.

Spaulding, Perley. The decay of hardwood slash in northern New England. Submitted for publication in Journal of Forestry. Typewritten, 9 pp. November, 1928

Spaulding, Perley. Report on the experimental cutting plots established on Harpoon Brook, Newfoundland by the Anglo-Newfoundland Development Company in 1921. Typewritten, 2 pp. December, 1928.

Westveld, M. Report on experimental areas of the Anglo-Newfoundland Development Company on Harpoon Brook, Newfoundland. Typewritten, 5 pp. December, 1928.

Plans

As soon as suitable areas are cut additional slash plots will be established on slopes which are not yet represented. As soon as the 4 quarters of the compass are represented in such plots the entire necessary series will be considered established. Most of the work of the future will be that of study of the progress of decay in these permanent plots Opportunities for reconnaissance studies on slash in special situations or under special conditions will be utilized as much as possible. This will necessarily have to be continued indefinitely for the present.

Assignment

Perley Spaulding, J. R. Hansbrough, M. Westveld, and H. J. MacAloney, in cooperation with the Harvard Forest.

1929 Major Project

MANAGEMENT

Project

Methods of cutting and reproduction in spruce types (Mc-1).

Scope

To determine (a) the best methods of cutting to use to secure satisfactory natural reproduction in the shortest possible time, and (b) the rate of growth of seedlings and larger trees left after cutting.

Status

This study is being conducted through the establishment of a large number of

temporary sample plots, supplemented by permanent sample plots, on which various methods of cutting are being tried out. During 1924 and 1925, 420 temporary plots were established throughout the spruce region. Four ½-acre permanent plots were established in 1924 in the White Mountains, and 2 additional ones in 1927 on the Battell Forest in Vermont. Fourteen permanent methods of cutting plots established by the Forest Service in New Hampshire and Vermont about 20 years ago help to form the basis of this study. During 1927 2 series of weeding plots in 4-year-old cuttings, one on the Battell Forest of Vermont, the other in the White Mountains, were established. These plots were subjected to weedings of varying degrees of intensity to determine their effectiveness in increasing the representation of spruce and fir in the next rotation. To determine what type of seed bed is favorable to spruce and fir, 38 small plots in 1926 and 48 in 1927 were laid out and sowed to spruce and fir seed. Tallies are made several times each reason to record germination and survival.

Results

Some of the more important facts brought out by the study are: (1) cut-over spruce lands are generally well stocked with spruce and fir reproduction; (2) nearly all this reproduction is advance growth which was present in the stand prior to cutting; (3) regardless of the severity of the cutting, most areas show an abundance of reproduction; (4) quantity of reproduction varies with froest type, spruce-slope showing the largest number, spruce-flat next, and spruce-hardwood least; (5) in general, the largest number of spruce and fir seedlings were found on areas which had originally supported the largest volume of spruce and fir; (6) where beech and hard maple form an appreciable portion of the stand, any type of cutting, unless followed by special cultural treatment, results in the rapid encroachment of hardwoods on areas formerly occupied by spruce and fir; (7) in the undisturbed forest, spruce maintains its dominance over fir without much difficulty, clear-cutting, with its resulting changes, transfers this supremacy to the fir; (8) competing hardwood growth is the most disturbing single factor operating to prevent the final establishment of spruce and fir; (9) clear-cutting of spruce and fir halts additional restocking of these species for many years following cutting. On the other hand prolific seeding of large residual hardwoods results in the establishment of much additional hardwood growth; (10) promiscuous cutting of young growth in some instances may be chiefly responsible for the conversion of former mixed spruce and hardwood stands into pure hardwoods.

Progress for 1928

Two additional methods of cutting plots were established in Waterville Valley, White Mountain National Forest. Another series of 3 weeding plots, also in the Waterville Valley, was established in 9-year-old spruce cuttings. Fifty additioanl seed bed condition plots were laid out on the Cherry Mountain area in the White Mountains. Further studies of soil types on the Cherry Mountain plots were made in cooperation with M. F. Morgan of the Connecticut Agricultural Experiment Station. A study of 12 sample plots in Newfoundland in which various methods of cutting and slash disposal were tried out indicates that none of the methods of cutting employed have proved a success from the standpoint of increasing the representation of spruce.

Publications and Reports

Westveld, M. Logging damage to advance reproduction. Journal of Forestry. Vol. 24, No. 5:579-582. 1 table. May, 1926.

_____ Observations on cut-over pulpwood lands in the Northeast. Journal of Forestry, Vol. 26, No. 6:649-664, 2 tables, 2 figures. May, 1927.

_____ Suggestions for the management of spruce stands in the Northeast. Typewritten, 30 pp. December, 1928. (To be published as Department circular, Forest Service.)

_____ Reproduction on pulpwood lands in the Northeast. Typewritten, 85, pp., 24 figures, 27 tables, 17 plates. May, 1927. (To be published as a technical bulletin, Forest Service).

_____ Report on the experimental cutting plots established on Harpoon Brook, Newfoundland by the Anglo-Newfoundland Development Company in 1921. Typewritten, 4 pp. November, 1928.

_____ Maintaining pulpwood species on cut-over lands Typewritten, 12 pp., 5 figures. February, 1929. (Accepted for publication by the American Paper and Pulp Association and by the Pulp and Paper Magazine of Canada).

Plans

The 4 methods of cutting plots established in 1924 will be remeasured and mapped in 1929. Tallies of reproduction on seed bed condition plots will be continued and additional ones will be laid out. Studies on the effect of girdling hardwoods to release young spruce will be studied. Possibly a study of reproduction conditions on spruce burns will be undertaken. Continued cooperation with the Connecticut Agricultural Experiment Station in the study of soil types and their relation to reproduction conditions is planned for the comming year.

Assignment

M. Westveld.

1929 Minor Project

MANAGEMENT

Project

Pruning of northern white pine (Mp-1).

Scope

To determine the effect of pruning on northern white pine at various ages, at various periods during the year, and in stands of various densities.

Status

The working plan for this project has not been prepared and the project has not been started, although it was planned to get it under way in 1927 and again in 1928. However, owing to the amount of work necessary on current projects it is doubtful whether anything can be done on this until the station personnel is increased.

Plans

Three 1/10-acre sample plots are to be established in young natural reproduction or plantations at Mount Toby. One plot will be pruned before the growing season begins, a second during the growing season and a third will be held intact as a check plot. Additional plots are to be established later in stands of various densities and with pruning of varying severity. Also tests are to be made to determine if pruning in transplant beds has any effect on height growth and later development.

Assignment

P. W. Stickel, in cooperation with Massachusetts Agricultural College.

1929 Major Project

MENSURATION

Project

Development of universal taper and volume tables (ME-1).

Scope

To determine the conformity of various species to a form equation which can be used for the construction of standard taper curves, and the application of such curves in mensuration work. Attention has been given to the following lines:

1. Conformity of various species to a form equation.
2. Study of fundamental principles of tree growth
3. Improvement of technique for preparing volume tables by the form class taper curve method
4. Study of factors affecting average form of stands of spruce and fir, and of methods of determining average form in the field
5. Study of factors affecting butt swell and bark thickness of spruce and fir.
6. Study of comparative form of species in mixture.
7. Study of change in form of residual spruce and fir trees after logging.

Status

Results under objective 1 have been completed and published. Under objective 2, measurements have been taken for two seasons on six white pine trees in cooperation with the Harvard Forest. The march of diameter growth at breast height and at a

point half way up the stem is recorded on these trees by means of a vernier and tape. The treatment of the individual trees is designed to show the effect of thinning and pruning upon changes of stem form. In addition, the study affords some basis for correlating growth at breast height and at a point half way up the stem with meteorological conditions, especially wind movement. During the past season the tape measurements were supplemented by a continuous dendrograph record of growth at breast height on one of the trees. The dendrograph was furnished by the New York State College of Forestry at Syracuse, New York. The records for 1928 have not been analyzed as yet.

Under objective 3, several mathematical and graphical improvements in technique of preparing form class volume tables have been incorporated in the publication presenting results of objective 1. The attempt to eliminate the artificial effect of height upon form quotient by the use of a new form index had to be given up because no practical method of converting the new normal diameters to actual breast height diameters could be found.

All the field work with spruce and fir planned for this project under objectives 4, 5 and 6, has been completed. Analysis of the spruce and fir field data has also been completed, and the material is ready for the preparation of final report. For these objectives 2,189 individual tree records were obtained in the course of 3 field seasons. These data were secured from 74 different stands, representing a great variety of types, mixtures, ages, sites, and densities. Practically all the measurements in second growth were secured by climbing the trees. The distribution of the data by species and types of growth is as follows:

	Red Spruce	White Spruce	Balsam	All Species
Even aged	664	601	347	1612
Old growth	345	---	232	577
Total Number Trees	1009	601	579	2189

After preliminary calculations on each individual tree record was completed the data were transferred to punch cards for machine tabulation. The machine work was planned to make possible a study of multiple correlation between any of the variables involved. From the machine tabulations a large number of multiple correlations have been calculated, and alinement charts with corrections for curvature were worked out for these combinations of variables offering the most promising results for the estimation of average form quotient and for the reduction of breast height diameter for bark thickness and butt swell.

Under objective 7 careful measurements were taken in 1924 on 41 red spruce and 40 balsam fir trees prior to logging on the Mc-1 permanent sample plots at Cherry Mountain, New Hampshire. These trees have been described and tagged and crown maps of the entire area before and after logging have been prepared, so that the change in form after logging can be followed by subsequent remeasurement at five-year intervals. Since the best spruce had been removed from this area about 50 years previously, increment borings, at each tenth of the stem as far as it was possible to

climb, were taken at the time of measurement in the hope that the development of the trees following the earlier cutting could be worked out. These borings have been analyzed and a detailed memorandum of results is in the files.

Results

Results covering objectives 1 and 3 were published in the Journal of Agricultural Research in 1927. In this paper it was shown that a large number of commercial conifers conform satisfactorily to the stem curve equation advanced by the author, and that this equation lent itself to simple mathematical and geographic manipulations as the basis for volume tables which could be applied in a practical manner. A detailed analysis of the sources of error in applying volume tables was also included and certain advantages of the form class system pointed out.

Although results under objectives 4 an 5 were not as uniform or as satisfactory as might be desired, it appears that average form quotient may in general be estimated from diameter, height, and site index, or diameter, height, and crown per cent. For old growth red spruce it was found that from quotient 73 would apply quite generally independent of mixture, except where stands had been culled or broken, when form quotient 70 should be used.

Although butt swell is shown to be dependent upon the diameter of the tree to a certain extent, very little of the variability of butt swell could be associated with any of the measureable factors. Practically all the variability of bark thickness which can be accounted for is also associated with diameter.

Since little could be learned of factors influencing butt swell alone, attention has been devoted to developing an equation or chart for estimating the combined effect of butt swell and bark thickness on the breast height diameters, for use in applying form class volume tables in practice. For even-aged stands the total reduction of breast height diameter for butt swell and bark thickness may be most satisfactoraly estimated from diameter and age and on old growth stands, where age is meaningless, diameter alone will be used.

The data proved inadequate as a basis for detailed study of comparative form of species in mixture (objective 6). All that may be said is that in mixtures white spruce and balsam will usually average lower in form quotient than red spruce.

Progress in 1928

Work in 1928 was confined to completion of analysis of the correlation data.

Publications and Reports

Behre, C. E. Preliminary notes on studies of tree form. Journal of Forestry 21(5):507-511. 1 table. May, 1923.

_____ Is taper based on form quotient independent of species and size? Journal of Forestry 22(3): 282-290. 3 figures, 1 table. March, 1924.

_____ Computation of total cubic contents of trees. Journal of Forestry 22(6):62-63. October, 1924.

_____ Comparison of diameter tape and caliper measurements in second growth spruce. Journal of Forestry 24(2): 178-182. 2 tables. February, 1926

_____ Chart for application of percentile taper curves to trees of any size class. Journal of Forestry 24(3): 272-274. 1 figure. March, 1926.

_____ Form class taper curves and volume tables and their application. Journal of Agricultural Research 35(8):673-744. 17 tables, 28 figures. October 15, 1927.

_____ Notes on use of form quotient based on full stem instead of form quotient for portion above breast height. Typewritten 1 page. April 18, 1924.

_____ New basis for classifying trees by form. Typewritten, 11 pp. 1926.

_____ Individual tree records for study of change in form of residual trees after logging. Typewritten, 6 pp. February 23, 1926.

_____ Memorandum of office computations. Change in form after logging. Typewritten, 7 pp. October 16, 1926.

_____ Notes on use of logarithmic coordinate paper for conversion of individual tree measurements to percentile tapers. Typewritten, 2 pp. April 15, 1926.

_____ Notes on tests of form curves by localities. Typewritten, 2 pp. November 10, 1926.

_____ Memorandum on check of preliminary volume tables. Typewritten, 4 pp. November 22, 1926.

_____ Memorandum on relative accuracy of bark borer and hatchet for measuring thickness of bark. Typewritten, 4 pp. December 7, 1926.

Plans

Nothing further is planned under objectives 1, 2, and 3. Behre will finish his final report covering objectives 4, 5, and 6 this year. This will be submitted for publication in the Journal of Agricultural Research.

For the study of change in form after logging, the trees on the Cherry Mountain sample plots should be remeasured in the late summer of 1929.

Assignment

C. E. Behre and _____.

MENSURATION

Project

Growth and yield of spruce and balsam fir (ME-2).

Scope

To determine the growth and yield of spruce and balsam fir in different types and in even-aged and uneven-aged stands.

Status

This project has so far been limited to the study of the yield of even aged, second growth stands of red spruce, white spruce and balsam fir. Such stands are most often found on old pasture lands. Field work has included the measurement of some 400 temporary sample plots in various parts of Maine, New Hampshire, Vermont, and New York. These are believed to include representatives of all the fully stocked stands of spruce and balsam fir of the desired character to be found in the Northeast. The analysis of this data has been completed and the report written.

Fifteen permanent sample plots from 0.1 - 0.3 acres in size have been established in spruce stands of varying density and ages. Five of these are located on the Battell Forest in Vermont in cooperation with the state of Vermont and 10 are on or immediately adjacent to the Gale River Experimental Forest near Twin Mountain, New Hampshire. These plots will eventually serve as a check on the results obtained from the measurement of temporary plots and provide information on mortality, approach of understocked stands to normal stocking, change in form of trees, and rate of growth in diameter, height and volume.

Except for the establishment of 1 permanent sample plot of .3 acres on the Gale River Experimental Forest in 1928 nothing has been done on the very difficult and highly important part of this project, that is, the yield of spruce and balsam fir in uneven-aged stands mixed with hardwoods. Throughout the Northeast all but a small portion of spruce and balsam fir pulpwood comes from mixed stands of spruce, balsam fir and hardwoods.

Results

Yield tables in peeled cubic feet per acre and in board feet per acre by the International 1/8 rule have been prepared for normal (fully stocked) stands of red spruce from 25 to 115 years in age and for site indices 30 to 70, and of white spruce and balsam fir from 25 to 85 years in age and for site indices 40 to 70. For red spruce on the average site the mean annual volume production in cords for a rotation of 60 to 75 years is about 3/4 cord per year. For a 75 to 85 years rotation, the mean annual growth in board feet is 300. At 65 years of age on the average site (site index 50) the total cubic foot volumes for red spruce, white spruce and balsam fir are 5250, 4920, and 4950 cubic feet respectively. At 85 years the board foot volumes by the International 1/8 Rule are respectively 26,300, 23,500 and 22,050 board feet.

In understocked stands the proportion of cubic foot volume to the fully stocked volume is much greater than the proportion of actual number of trees to the fully stocked number of trees. Red spruce stands with about 65% of the normal number of trees have the maximum board foot volume. However, the larger the number of trees, the greater is the total cubic foot volume. Moderate amounts of balsam fir and white spruce in a stand have practically no effect on the yields. The distribution of stems among the diameter classes of a stand follow a regular progression, based on the size of the average tree. Understocked stands approach a more fully stocked condition with advance in age.

Progress for 1928

Eleven permanent sample plots from .13 to .35 acres in size were established on or immediately adjacent to the Gale River Experimental Forest near Twin Mountain, New Hampshire. Ten of these were in pure stands of different ages and degrees of stocking and 1 was in a stand of spruce mixed with hardwoods.

Publications and Reports

Meyer, W. H. Yields of second growth spruce and fir in the Northeast. Typewritten, 64 pp., tables, graphs, plates. May 20, 1926. (To be published as a bulletin by the United States Department of Agriculture).

Plans

Owing to priority of other requirements no additional work except incidentally is planned on this project for the present. But as soon as possible a study of yield in uneven-aged, mixed softwood and hardwood stands must be undertaken in a comprehensive way.

Assignment

1929 Minor Project

MENSURATION

Project

Regional yields (ME-1, WO).

Scope

To bring together systematically all available data on the present and potential growth and yield of different species and types in the Northeast.

Status

This is a part of a Service-wide project which originated with the compilation of all available growth and yield data for use in preparing the report on "Timber: Mine or Crop?" Material pertaining to it is being secured as an integral part of several projects now under way.

Results

No progress has been made on this project.

Plans

Information will be secured incidentally as opportunity offers. An effort will be made to obtain figures as to the actual cuts from second growth stands.

Assignment

Staff, Northeastern Forest Experiment Station.

1929 Minor Project

MENSURATION

Project

Converting factors (ME-2, WO).

Scope

To bring together systematically information upon converting factors used for converting timber measured in one unit into another unit.

Status)
)
Results)

This is an all-Service project upon which nothing has yet been accomplished.

Plans

Information will be secured incidentally as opportunity offers.

Assignment

Staff, Northeastern Forest Experiment Station.

MENSURATION

Project

Manual of field methods (ME-4, WO).

Scope

To prepare a manual covering the methods used in field studies, and particularly in sample plot work, in order to obtain more comparable results from studies undertaken by different agencies and in different forest regions through greater uniformity in the collection, compilation, and analysis of field data.

Status

A special committee with the Chief of Forest Experiment Stations as chairman and including representatives of the Forest Service, Society of American Foresters, and Association of State Foresters, was organized in 1926 to handle the project.

Results

An outline of the proposed manual has been circulated and commended on in some detail by the Station.

Publications and Reports

See under M - 5.

Plans

To obtain further information for the manual as opportunity offers.

Assignment

Staff, Northeastern Forest Experiment Station, in cooperation with special committee.

PROTECTION

Project

Chestnut blight (Pd-1).

Scope

To study all phases of the chestnut blight, with special reference to the feasibility of replacing the practically extinct native chestnut with resistant varieties or species, or through the development of resistant hybrids.

Status

The location of possible resistant trees of the native chestnut is being continued. While the tree is extinct as a timber species, it is still so well represented in the forests by partly dead trees, sprouts, and recent seedlings that it is difficult to distinguish resistant individuals. With further mortality it is believed that such trees will be more readily found.

Results

The work to date has resulted in calling the attention of the public to such possibilities and the establishment of contacts which may lead to the discovery of resistant trees. As foreign stock of resistant species becomes available for test it can be planted on certain reserved lands of this vicinity which seem desirable for such a purpose.

Progress for 1928

Practically none.

Publications and Reports

None.

Plans

Further work to be continued as at present until some definite lead may call for more extended investigations.

Assignment

Perley Spaulding.

1929 Major Project

PROTECTION

Project

White pine blister rust (Pd-2).

Scope

Investigation of scientific aspects of the disease.

Status

The results of past investigations have been largely published. Studies of conditions in Europe have been submitted for publication as a technical bulletin of the Department of Agriculture. The use and adequate testing of resistant species of white pines is being advocated and assisted.

Results

As a result of the European studies, supported by more recent publications in Europe, it has been determined that the Balkan white pine, Pinus peuce, is very resistant, if not immune, to the blister rust. An attempt has been made to bring this fact to the attention of every one who is making experimental plantings within the ranges of the white pines so that they may start tests so planned that this species will adequately show its forestry possibilities as well as its resistance to the disease. Seeds were secured in the spring of 1926 and distributed to the state foresters of New England and New York with the understanding that they would grow seedlings in their nurseries and at the proper time plant them on state lands where such tests can run for an indefinite period undisturbed. Again in 1927 seeds from native forests of Roumania were secured and distributed to the foresters of the states of New England, New York, and Pennsylvania for the same purpose. It is hoped thus to have this species tested under various conditions in the Northeast. In other sections it is hoped to get the foresters who should be interested to get seed themselves and make such tests. The large planting experiment at Wilmington, New York, will be continued indefinitely. For the present, it is proposed to make merely routine and incidental studies on this disease.

Progress for 1928

Work for the current year has consisted of the correction of a manuscript and reading proof of a Department technical bulletin.

Publications and reports

Spaulding, Perley. The white pine blister rust: a comparison of European with North American conditions. United States Department of Agriculture technical bulletin, in page proof. January, 1928.

Plans

Merely routine and incidental studies. This is a permanent factor in the Northeastern forests and can never be entirely finished. Continue the experimental plantation at Wilmington, New York.

Assignment

Perley Spaulding and J. R. Hansbrough.

PROTECTION

Project

Pitch pine blister rust (Pd-3).

Scope

To determine the behavior of this native disease in comparison with the closely related introducted white pine blister rust.

Status

It has been possible to give this but little attention during the past year. It is hoped to bring it to a close soon.

Results

Considerable data have been accumulated, which it is believed are sufficient to justify publication.

Progress for 1928

Some additions to collections from new localities.

Publications and reports

Spaulding, Perley. Notes upon Cronartium comptoniae. Phytopathology, 3:62. 1913.

_____ Notes on Cronartium comptoniae II. Phytopathology, 3:308-310. 1913.

_____ Notes on Cronartium comptoniae and C. ribicola. Phytopathology, 4:409. 1914.

_____ Notes on Cronartium comptoniae III. Phytopathology, 7:49-51. 1917.

Plans

Prepare for publication the material already on hand. Date of completion indefinite because of lack of time to write the manuscript.

Assignment

Perley Spaulding.

PROTECTION

Project

European larch canker (Pd-4).

Scope

To determine the distribution, hosts and life history of this introduced tree disease; its relation to the native American fungus of larch and other conifers; and to eradicate diseased trees so far as possible.

Status

In the spring of 1927 the true European larch canker was discovered at Hamilton, Massachusetts on imported European larches, which had been growing in that locality for about 20 years. Investigation showed that it was also present on four other estates scattered in adjoining towns, and on single estates in Wellesley and Groton. It was soon found that the disease was present on Douglas fir and western yellow pine, as well as on native eastern larch and Japanese larch and a single tree of Scotch pine. There is a native fungus which very closely resembles the imported one and which is generally distributed on the native eastern larch from Newfoundland southward and westward an unknown distance. Fortunately the native fungus is not an active parasite, while the European fungus is decidedly parasitic in action on living trees. Much scouting has been done to locate European larch and Douglas fir plantations since this discovery was made.

Results

To date the disease fortunately has been found in relatively few places and singularly restricted in distribution in those localities. In fact, it can be said that it quite probably occurs only where it has been brought in upon diseased nursery stock. Thus far it has apparently spread very little from the imported trees although it attacks them virulently. Because of this slow spread there seems to be an excellent chance for the complete eradication of the larch canker from this country by prompt action and a comprehensive program of scouting to ensure its discovery in other possible localities and states.

Progress for 1928

Scouting has been continued in all plantings of European larch, Douglas fir and western yellow pine that could be located in New England. A number of places scouted last year have been re-examined. The situation at present is as follows:

Matthews Estate, Hamilton, Massachusetts

This was the first place where the larch canker was found in this country. It is present only in plantations of imported trees so far as we can determine: the European larch stock has definitely been traced to a nursery in Scotland. The disease is present generally in that part of Scotland. Numerous individuals of the imported trees now have old cankers at the base on wood which must have been formed

when the trees were imported. There seems to be no doubt that the disease came in on the stock and has been present on those trees ever since. Importations of Japanese larch and of Douglas fir were made at the same time as those of the European larch and from the same nursery. The diseased trees are about 20 to 26 years old and have been in the plantations 20 to 24 years. On the European larch the disease has multiplied greatly during this time as is clearly indicated by the following figures of total stand and of diseased trees. On this estate the disease is not so serious on the Douglas fir, although it has made some progress. On western yellow pine it also has more than held its own.

	Total Number	Number Diseased
European larch	5000	34000
Japanese larch	2160	5
Hybrid larch	32	0
Douglas fir	2400	25
Western yellow pine	80	60

Considerable experimental cutting has been done on this estate, since permission was obtained to do so. All of the diseased Douglas firs and western yellow pines were cut and specimens taken from all for future study. About 400 of the European larches were also cut for the same purpose, and also to test methods of cutting and disposal.

All figures given here are based on trees which have cankers indicating parasitic action of the fungus. Sapropyhtic action is ignored, as it is so prevalent that its inclusion would mean the complete destruction of all of the larches of all species, of all Douglas firs and of numerous species of the pines throughout New England and doubtless all of the eastern states. Confusion with the native fungus compels this action.

The forested parts of this estate are being transferred to the control of the Harvard Forest; this transfer is apparently a complicated matter and is proceeding slowly. Upon its completion it is assured by Professor R. T. Fisher, head of the forest, that cutting will actively be done, if it is not done before. Because of this complication we were very fortunate to get permission to cut so extensively for experimental purposes. At the request of Professor Fisher all infected trees left on the estate have been plainly marked permanently for cutting. Recently the Matthews estate has had one or two men cutting the marked larches for destruction.

Palmer Estate, Ipswich, Massachusetts

This is the second in extent of the disease and number of trees involved. Some of the stock at least was furnished by Matthews of Hamilton, and all probably was. It is of the same age as the Matthews' stock, having been imported at the same time. Here the diseased plantings are along the slopes of a small river valley. The moisture conditions have apparently been very favorable for the disease and it has thrived

even more than at the Matthews Estate. The trees of all species except the Douglas fir have made much better growth than at the Matthews place, so that the cutting has required nearly as much labor as at the latter place, in spite of the smaller number of total trees to be cut. The trees involved are as follows:

	Total number	Number diseased
European larch	475	450
Japanese larch	1100	Very few; branches were removed and the trees saved.
Douglas fir	160	67
Western yellow pine	400	150
Scotch pine	?	1

Earlier in the season it was suspected that a native blister rust might be partly responsible for the disease in the western yellow pines, but after watching them through the season it is concluded that it is all due to the canker fungus, Dasyscypha. This was also true of this species on the Matthews Estate. Mr. Palmer was seen personally and told the status of his trees. He was also told definitely that the Federal men have no authority to compel destruction, and that our connection with the matter is purely advisory, both to himself and to the state officers, we being looked to for advice as to the correct manner of cutting and disposing of the felled material when such action is taken. All diseased trees found on his place were tagged during the summer without injury to the trees. Early in January all of the diseased trees of all species were cut by Mr. Palmer. Very careful work was done. The brush is to be burned when safe to do so and the trunks used for fuel on the place.

Lawrence Estate, Groton, Massachusetts

Here a peculiar situation was found. A considerable number of rather old European larches are healthy so far as can be determined. About 75 Douglas firs about 40 years old were found somewhat isolated from the larches. Of these 31, were found badly cankered and showing all of the symptoms of the disease. Permission was obtained to cut the affected trees and take such samples as we might care for. Because of the excellent representation of all stages of the disease on this species it was thought advisable to get a complete series from this locality. The diseased trees were cut. The brush is to be burned and the wood cut up and burned as fuel on the place. This is the farthest removed from the main center of the disease of any place yet found.

Rice Estate, near Ipswich, Massachusetts

There are several hundred native larches of various ages here. Two of them were found diseased. These are the only native larches that have definitely been found affected. Because of this they were valuable as specimens, and they have been secured by permission of the owner. No other diseased trees of any species were found on this estate.

Proctor Estate, near Ipswich, Massachusetts

A considerable number of larches and other tree species are on this estate. A single Douglas fir was found diseased. Upon recommendation this was removed and burned.

Hunnewell Estate, Wellesley, Massachusetts

This estate is famous for its many species of trees. Two Douglas firs were found diseased. It was recommended that these trees be destroyed and assurance was given that it would be done.

Batchelder (formerly Mrs. J. C. Phillips) Estate, near Wenham, Mass.

About 250 trees of Douglas fir, 12 to 18 inches in diameter and about 50 feet tall, were found. Of these, 56 were found diseased in all stages from dying to apparently thrifty, but with symptoms of the trouble. The owner gave permission to take 2 of the trees for specimens. He also asked to have all of the affected trees marked for cutting, implying that he would take them out this winter. No action has yet been taken.

Goddard State Park, Potowomutt, Rhode Island

Here are a large number of Douglas firs; part are 40 or more years old and part are about 15 years old. Among the larger trees is a large number which are badly diseased; some have evidently died from the canker. A few of the younger ones have been noted showing symptoms also. Because of concentrating attention on the area of Ipswich and Hamilton, Massachusetts little time has yet been given to this outbreak and no attempt has been made to eradicate the disease. This was found some time after the Massachusetts localities, in which work was already well under way. Recently at the request of the State Park Commission and the State Department of Agriculture the large diseased trees were marked for destruction. The small ones will be done later.

In all of the work so far done the trunks of the trees are to be burned for fuel on the estates and the small brush burned as soon as conditions will allow this to be done safely.

Publications and reports

Spaulding, Perley and P. V. Siggers. The European larch canker in America. Science, n.s., 66:480-481. November 18, 1927

Plans

Future work depends upon the definite allotment of money to this project. Much more extensive scouting should be done. Very careful comparative work upon the two fungi and their close relatives, involving cultures and inoculations, besides the usual mycological studies, is imperative if any progress is to be made improving our knowledge of the present situation.

Assignment

Perley Spaulding and J. R. Hansbrough.

PROTECTION

Project

Shade and ornamental tree diseases (Pd-5).

Scope

To answer inquiries on this subject. While the Pathologist of the Northeastern Forest Experiment Station is definitely directed to investigate those problems which the Director of the Station considers necessary, any communications on shade and ornamental tree diseases are referred to him as being best qualified to answer them satisfactorily.

Status

Entirely incidental and limited to local cases. A few each year require handling.

Results

The European larch canker was brought to the Pathologist's attention as a result of an inquiry accompainied by a specimen of a diseased tree. Such inquiries usually do not add to our scientific knowledge, but occasionally out of the way things like this are encountered.

Progress for 1923

A few cases handled during the year.

Publications and reports

None except as mentioned under the European larch canker project.

Plans

Routine examination of specimens submitted and answer of inquiries.

Assignment

Perley Spaulding.

PROTECTION

Project

Miscellaneous forest tree disease (Pd-6).

Scope

To include all miscellaneous work upon forest tree diseases which involve too little work to justify a separate project, and new lines of work before they develop into separate projects.

Status

A considerable number of specimens of tree diseases and of the fungi causing them are accumulated; these are valuable for reference and are filed for such use. A few exhibit specimens are collected and placed about the laboratory where visitors can see them. Indexing of literature on forest tree diseases of the Northeastern states is necessary for the knowledge of what is to be expected, for methods of treatment and investigation, for hosts and for distribution. This is handled on a basis aimed to conserve time and labor, yet furnish the needed information. A number of canker diseases of the hardwood trees which appear to be caused by species of Nectria have been encountered; it is hoped to make some study of them in the near future, as it is certain that they are causing heavy losses locally. In connection with the investigation of slash decay it has become apparent that the fungus Stereum sanguinolentum, common as a rapid decay agent of coniferous wood, is likely to assume increasing importance with the advance of our knowledge of it and its work; it seems desirable to push this as far as possible in connection with other more urgent work. A small amount of field work upon the Scotch pine blister rust has been done.

Results

Discovery and early investigation of the European larch canker, now given a separate project of its own. The finding and preliminary investigation of Nectria canker diseases of numerous hardwood species, which quite certainly will assume considerable importance in the near future. The placing of Stereum sanguinolentum in the class of threatening fungi with an ominous future.

Progress for 1928

Several different species of Dasyscypha have been encountered. It is likely that it will be found that some of them are disease causing fungi. A locally serious disease of white pine apparently caused by Caliciopsis pinea has been found to be widely distributed in New York and New England. More attention should be given it.

Publications and reports

Spaulding, Perley. A serious disease of birches. Phytopathology, 17:59. 1927.

Plans

It is proposed to continue the present lines of work as supplementing that carried on under definite projects.

Assignment

Perley Spaulding and J. R. Hansbrough.

1929 Major project

PROTECTION

Project

Weather and fuel relationships (Pf, B-5).

Scope

To determine the relationships between weather conditions and the inflammability of forest fuels.

Status

In 1925, a fire weather station was set up at the College of Forestry Camp, Cranberry Lake, New York. It was maintained with the cooperation of the New York State College of Forestry, Syracuse, New York, and the Empire State Forest Products Association, Albany, New York. Two additional stations -- Petersham, Massachusetts, and Elk Lake, New York -- were established in 1926. The Petersham station was established with the aid of the Harvard Forest, Petersham, Massachusetts, and that at Elk Lake with the assistance of the New York Conservation Department, Albany, New York, and Finch, Pruyn and Company, Glens Falls, New York. The Maine Forest Service contributed the funds for a fourth station located at Smyrna Mills, Maine, which was opened in 1927. All of the above agencies have continued cooperating, so that the different stations have been maintained continuously from their dates of establishment.

The forest types in which the stations are located are as follows:

Cranberry Lake, in the northern mixed hardwood-softwood type; Petersham, in the northern white pine-eastern hardwood type; Elk Lake, in the lower red spruce-balsam slope type; and Smyrna Mills, in the red spruce-balsam fir flat type.

Thus measurements are being secured in the two most important forest regions of the Northeast, namely, the white pine and the northern mixed hardwood-softwood region.

At each investigational area duplicate meteorological stations are set up: one in the open and a second in adjacent green timber. Four daily observations at 8 a.m., 11 a.m., 2 p.m., and 5 p.m., are made of the following meteorological factors and forest fire hazard conditions: Air temperature and air pressure within the instrument shelter, relative humidity, vapor pressure, depression of the dew point, duff temperature at surface, soil temperature at one inch depth, duff moisture content at surface, duff moisture content at one inch depth, evaporation at soil level, wind velocity at 3½ feet above the ground, precipitation, and cloud formation. In addition to the routine observations, continuous records of air temperature and relative humidity are obtained by hygrothermographs located in the instrument shelter of all open stations.

In order to evaluate expressions of duff moisture content into terms of actual forest fire hazard, inflammability tests have been made at 2 stations -- Petersham and Smyrna Mills. For these tests such common fire brands as matches, cigarette butts, pipe heels, and small camp fires are used. The factors measured during such tests are: relative humidity, air temperature, duff moisture content by means of individual samples collected before conducting the test, wind velocity in feet blowing across the duff, and duration of test in minutes and seconds.

Continuous readings on the drying-out rate of the duff in the open and in the forest under various types of weather have been secured at all 4 stations. These readings, taken at 15 minute intervals throughout the day augment the routine observantions. The factors measured are dry and wet bulb temperatures, duff temperature, duff moisture content in surface layer, and cloud formation.

In general the Petersham station has served as the central station in the fire weather studies. Excellent opportunities have been available to tie in this project with the study of the relation of solar radiation and soil moisture to tree growth (T-1). During the 1926 field season daily radiation data were secured at the open and forest stations. For 3 months during 1927 3 different solar radiation intensity stations were established by shielding the duff with frames covered with various thicknesses of cheese cloth. One station was fully exposed, a second was shielded by a screen which allowed only 30% of full radiation to fall upon the duff, and a third, which received approximately 50-60% of full radiation. On these areas duff moisture content in surface layer, duff temperature, and light intensity were measured.

Since 1927 daily telegraphic reports have been forwarded to the Weather Bureau offices at Albany, New York, and Boston, Massachusetts from the stations at Cranberry Lake and Smyrna Mills, respectively. The officials in charge of these Weather Bureau offices have spoken very highly of such information and are using the reports in the program of fire weather warnings.

The data secured at the 4 fire weather stations have been coded and transferred to punch cards, which in turn have been sent to Washington for sorting and tabulating. Each winter the tabulations have been averaged and summarized.

At Amherst, year-long evaporation records have been taken with the Bates' evaporimeters, since January, 1927. The instruments are read 3 times each month. These evaporation data will be of use in the fire weather studies, especially in showing the air moisture conditions preceding the fire seasons in the spring.

Results

No comprehensive analyses of the data have been made to date, since it is planned to secure a minimum of 5 years' records for each station before commencing on any detailed report.

Preliminary studies of the records indicate that in the absence of precipitation, relative humidity seems to be the controlling factor of fire hazard. Between rainy periods (where the moisture content of the atmosphere and of the duff are at equilibrium) there is a very close correlation between the amount of moisture in the atmosphere and the moisture content of the duff in the surface layer and at one inch below the surface. Other factors which appear to be of primary importance are air temperature, duff temperature, and solar radiation. These last mentioned factors play an important part in changing the water in the duff from a liquid to a gas in which form it is lost into the surrounding air. In general, there is every indication that during the fire seasons, 2 p.m. air temperatures of 70°F., and relative humidities of 40% or less are indications of hazardous fire conditions. Vapor pressure thus far has been the best guide to the trend of the weather.

The inflammability tests show that when the duff moisture content falls below 20 per cent, fires are started by all the fire brands used in this work. The ease with which fires can be started with matches, pipe heels, cigarette butts, and small camp fires depends upon the quality and structure of the duff, as well as upon the moisture present. Thus, for example under equally low duff moisture conditions, fires can hardly be started with matches in pure red spruce-balsam fir duff, while with an increase of hardwood leaves into such a mixture of coniferous leaf-fall fires are started without any difficulty by this fire brand. Similarly, while pipe heels and cigarette butts often fail to start fires in pure hardwood duff even when the moisture content is very low, the same fire brands are extremely dangerous in the compacted coniferous duff. In general the fire brands can be rated as follows from the most dangerous to the least dangerous: camp fires, matches, pipe heels, and cigarette butts.

Progress for 1928

All 4 stations were set up and maintained during 1928 with the cooperation of the agencies listed above. The Cranberry Lake station was in operation from April 8 to October 4; the Petersham station from April 13 to November 24; the Elk Lake station from May 10 to October 12; and the Smyrna Mills station from June 10 to October 12. There are now 4 years' data for Cranberry Lake (1925-1928); 3 years' data for Elk Lake and Petersham (1926-1928); and 2 years' data for Smyrna Mills (1927-1928). Approximately 250 continuous observations on the drying-out rate of the duff have been made since the investigations began in 1925.

There were no changes in the routine methods of making observations. During the past field season soil moisture determinations were made at all stations excepting Elk Lake. The soil samples were collected at both open and forest stations at 2 p.m. daily. In order to find out exactly how much water is retained in the duff after different amount of precipitation, duff samples were collected and dried out at Petersham, Cranberry Lake, and Smyrna Mills whenever the duff hygrometer readings exceeded 50 per cent.

The inflammability work was extended to the Cranberry Lake station. There are now 525 tests for the northern white pine-eastern hemlock duff at Petersham; 125 tests for the northern mixed hardwood-softwood duff at Cranberry Lake; and 300 tests for the red spruce-balsam fir type at Smyrna Mills.

As in the past year, daily telegraphic reports were forwarded to the Weather Bureau offices at Albany, New York and Boston, Massachusetts from the stations at Cranberry Lake and Smyrna Mills, respectively.

Publications and reports

Stickel, P. W Importance of meteorological studies in forest fire prevention. In Proceedings of Forest Protection Conference, New York State College of Forestry, 58-68. 6 figures. November, 1926.

_____ Instructions to fire weather observers. Typewritten, 12 pages. January, 1927.

_____ Forest fire weather research. Journal of Forestry 5:604-605 May, 1927.

_____ Report to the Empire State Forest Products Association of progress at the Elk Lake fire weather station. Typewritten, 8 pages. October, 1927.

_____ Forest fire weather research. Mimeographed by Quebec Forest Industries Association, Ltd. 10 pages. January, 1928.

_____ Comparative forest fire hazard in the Northeast. Journal of Forestry 4:456-463. 1 table. April, 1928.

_____ Forest fire weather in central Massachusetts. Monthly Weather Review 56:134-136. 4 figures, 2 tables. April, 1928.

_____ The problems and aims of fire weather research under way at the Northeastern Forest Experiment Station. Typewritten, 8 pages. December, 1928.

Gast, P. R. and Stickel, P. W. Solar radiation and relative humidity in relation to duff moisture and forest fire hazard. Typewritten, 8 pages. 1 plate, 1 table. (To be submitted to Monthly Weather Review).

Plans

The 1928 data will be transferred to punch cards, sorted, and tabulated as rapidly as possible. All stations will be set up and operated during the coming field season. The inflammability work will be continued with some attempt to imitate sparks from railroads engines. With the close of the 1929 season, 5 years' data will be available for Cranberry Lake, and a comprehensive report will then be started

the work at that station. It is planned to continue work at all the remaining stations until 5 years' data shall have been secured for each one and it may be necessary to continue until a season of greater fire hazard develops than has appeared since the study began.

Assignment

P. W. Stickel, in cooperation with the New York State College of Forestry, the Harvard Forest, the Maine Forest Service, the New York State Conservation Department, Finch, Pruyn and Company, The Empire State Forest Products Association, and the United States Weather Bureau.

1929 Major project

PROTECTION

Project

Prediction of fire weather (Pf, C-7).

Scope

To work out methods for predicting the occurrence of fire weather more accurately and for longer periods in advance than is now possible.

Status

This is primarily a Weather Bureau project which is, however, closely connected with the study of weather and fuel relationships (Pf, B-5), and in which the Experiment Station cooperates actively in translating predictions of fire weather into terms of actual fire hazard. Seventeen special fire weather stations have been installed in the New England states and in addition the Massachusetts Agricultural Experiment Station and the Winter Hill Observatory at Worcester, Massachusetts furnish records. These stations report to Boston. Several fire weather stations have been established in New York from which reports are sent to Albany. The special fire-weather station located in Connecticut, as well as the regular Weather Bureau station at Harford forward daily special messages to New Haven. This distribution of messages received by the Bureau makes available the necessary information at the 3 fire-weather forecasting centers of this district, Boston, Albany and New Haven.

Results

Beginning in 1925 forecasts have been issued daily from the Boston office of the Weather Bureau by telegraph to various sections of New England during hazardous periods. Forecasts have been issued from Albany for New York.

Much has been done in preparing weekly normal, weekly mean maximum, weekly mean minimum, and weekly absolute maximum temperatures from March to December for each of the 10 sections into which the New England states have been divided for fire-weather purposes.

Progress for 1928

General progress was made in carrying out the Weather Bureau fire-weather plan. A total of 861 forecast messages were sent out by telegraph from the Boston office, in addition to the telephone distribution from the Albany and New Haven offices.

The research program has been going forward as rapidly as possible and at the end of the year a greater part of the initial selective tabulation work was completed, preparatory to an analytical study of conditions conducive to fire-weather.

Publications and report

None

Plans

Continue along the same general line. Issue fire-weather forecasts to the interested cooperators and to the general public through the medium of publicity. A general advancement in the research work is looked forward to, with the possible completion of a report anticipated ,based on the material available at this time.

Assignment

F. C. Crombie, Weather Bureau in cooperation with other Weather Bureau officials, Northeastern Forest Experiment Station, and State Foresters.

1929 Major Project

PROTECTION

Project

Analysis of forest fire statistics (Pf,D-2).

Scope

To secure from an analysis of available records as complete and accurate information as possible in regard to forest fire hazard, risk, and damage in different parts of the Northeast.

Status

Fire records have been tabulated and compiled for the 4 states with which the station is cooperating, as follows:

Maine	1915-1926
New Hampshire	1921-1925
Vermont	1909-1926
Connecticut	1921-1925

Reports for Maine and New Hampshire have been completed, the report for Vermont is in preparation and will be followed by that for Connecticut.

Results

Analysis of accurate fire statistics can aid greatly to a better knowledge of forest fires and their control, but analysis of incomplete and inaccurate statistics may be actually misleading. One fact brought out early in this study was the incompleteness and inaccuracy of many of the individual fire reports, which resulted in an agreement on a uniform individual fire report at the Boston Conference of State Foresters. This form has been adopted by the New England states.

In Maine the statistics show that while the number of fires and the damage sustained is not alarming, on the other hand the size of the average fire, 163 acres, is away beyond the average of 10 acres per fire sometimes set as the standard toward which control organizations should work. This is particularly true in the northern part of the state, with an average of 179 acres per fire, where various factors combine to make the prompt suppression of fires difficult. In the southern part of the state the average is 47 acres per fire. Special effort should be made to reduce the size of the fires. Smoking caused the largest number of fires.

In New Hampshire it is shown that although the number of fires in relation to forest area and to population appears relatively large, the total number is not excessive. The size of the average fire and the percentage of forest area burned are relatively low, although still considerably higher than the figures ordinarily used as a standard. Disastrous conflagrations are apparently rare, as is evidenced by the comparative uniformity in the number of fires, damage, and cost of suppression as between different years. The fire hazard is highest in the southern part of the state which, with 46 per cent of the forest area and 49 per cent of the population, has 78 per cent of the total number of fires. As a result, area burned, value of timber destroyed, and cost of suppression all bulk considerably larger in the southern than northern group of counties. On the other hand, the size of the average fire, the loss per fire, and the cost of suppression per fire average considerably higher in the northern group. Smoking is the outstanding cause of fires, being responsible for approximately half of the total number in every county in the state. Education of the general public as to the causes and seriousness of forest fires, strict enforcement of the forest fire laws, and the strengthening of fire protective organizations are probably the chief needs in the state. Specifically, these measures should aim at the reduction of the number of fires in the southern part of the state, particularly in Rockingham County, and of their size in the northern part.

Progress in 1928

Reports on Maine and New Hampshire completed.

Plans

Completion of reports for Vermont and Connecticut. Preparation of a report for the region as a whole. Tabulation of statistics for succeeding years.

Publications and reports

Dana, S. T. Forest fires in Maine, 1915-1925. Typewritten, 56 pp., 33 figures, 26 tables. 1928. (To be published as a bulletin by the Maine Forest Service.)

_____ Forest fires in New Hampshire, 1921-1925. Typewritten, 29 pp., 27 figures, 6 tables, 1928. (To be published in the biennial report of the Department of Forestry, State of New Hampshire.)

Assignment

S. T. Dana and P. W. Stickel, in cooperation with the state foresters of Connecticut, Maine, New Hampshire and Vermont.

1929 Major Project

PROTECTION

Project

Control of the white pine weevil (Pi-4).

Scope

To study the life history and habits of the white pine weevil and to determine practical and effective measures for its control and for minimizing the injury caused by it.

Status

This project was begun in May, 1925. The investigation has progressed far enough so that, with the exception of the permanent plot studies and certain life history studies which are to be continued indefinitely, preparation of the manuscripts is in progress.

Results

Some important information has been obtained on life history and habits which will be dealt with in detail in the manuscripts. The investigation has shown that the most advantageous way to protect white pine from this weevil is to grow it in mixture, preferably with some species that will be of value in the final crop. The choice of the species will be determined by the economic conditions in any given locality. A dense pure stand is practical only when it can be obtained naturally and at a high enough density to offset any weeviling which may occur. Direct control measures are generally too expensive for common practice. Control by parasitic predaceous insects, birds, wood mice, and moles is uncertain, but reduction in numbers of weevil by these agencies is undoubtedly of great importance.

Progress for 1928

The field season of 1928 was spent in checking over the permanent sample plots and in carrying on life history and habit studies.

Publications and reports

MacAloney, H. J. Habits and control of the white pine weevil (provisional title), approximately 50 pages, 1 figure, 15 plates, 5 graphs. To be completed in July, 1929. To be submitted as partial requirement for the degree of Doctor of Philosophy, New York State College of Forestry, Syracuse, New York.

_____ Habits and control of the white pine weevil (provisional title). Approximately 20 pages, 10 plates, 4 graphs. To be completed in July, 1929. To be submitted to Bureau of Entomology for publication as departmental bulletin.

_____ Mixed stands the best protection against the white pine weevil. 1 page. Forest Worker, March, 1928.

Plans

It is expected that two manuscripts will be completed early in 1929. Permanent sample plot studies and life history studies will be continued indefinitely, but the time spent on them will be curtailed.

Assignment

H. J. MacAloney, in cooperation with the Harvard Forest, New York State College of Forestry, Massachusetts Timberland Owners, State Foresters and Entomologists, and the Entomological Branch of the Dominion of Canada Department of Agriculture.

1929 Major Project

PROTECTION

Project

Control of the bronze birch borer (Pi-6).

Scope

To study the life history and habits of the bronze birch borer, and to determine practical measures for the control of the insect by forest management.

Status

Additional permanent sample plots were laid out on the White Mountain National Forest at Cherry Mountain, and also at Corbin Park Game Preserve, Grantham, New Hampshire. A survey was also made during the summer of 1928 in Michigan and Wisconsin, and a large number of temporary plots laid out and studied. Additional work in life history and habits was initiated.

Results

The results of the investigation carried on in the Northern Lake States confirm the information so far obtained in New Hampshire that the bronze birch borer seems to be secondary rather than primary. In the Lake States paper birch seems to be the favorite host, while in New Hampshire it is the yellow birch that is attacked most.

Progress for 1928

Investigation of the permanent plots laid out in 1927 showed that many of the trees which had shown leaf development were still living, but a few had died. Examination of these trees showed that some of them had been attacked by the borer, but some showed no evidence of attack. The information obtained from studying the temporary plots in the Lake States confirms this.

Publications and reports

Hall, R. C. Progress report for the bronze birch borer study in New England. Typewritten, 3 pages. December, 1928.

_____ The bronze birch borer. 1 page. Forest Worker, July, 1928.

Plans

This investigation will be continued in New Hampshire in the field season of 1929, and will probably be initiated in the states of New York and Vermont.

Assignment

R. C. Hall, School of Forestry and Conservation, University of Michigan, and H. J. MacAloney in cooperation with the Bureau of Plant Industry and White Mountain National Forest.

1929 Major Project

TYPES

Project

Relation of radiation (light) and soil moisture to tree growth (T-1).

Scope

To determine the role played by radiation (light) and soil moisture in the establishment and subsequent development of different species under various conditions. The species to be studied first are northern white pine and red spruce. Adequate apparatus and methods are to be developed where necessary.

Status

The radiometric equipment is practically through the stage of commercial development. The development of satisfactory soil moisture apparatus has not been accomplished. The relation of the growth of white pine to radiation intensities has been studied and a unique result obtained which must be confirmed before acceptance. Certain relations between relative humidity and radiation intensity have been examined. Further work in this direction is indicated.

Results

The spherical thermopile has been calibrated and examined as to its character as a precision instrument. Facilities for this had not been previously available, but were provided through the courtesy of the Eppley Laboratory, Incorporated, in permitting the use of their new photometric dark room. The instrument was found to be of good accuracy, of a rather large time lag as compared with certain types, and certain alterations were indicated to improve the uniformity of registration with varying angle of incidence. The time lag is not a disadvantage, but rather an advantage when used with a chopping recorder. The changes indicated for improvement of characteristics are now in progress.

That the electrical capacity method cannot be used for the determination of moisture in the soil in situ was found on further work. Capacities are swamped out when the attempt is made to form a capacity containing soil as the dielectric below the surface of the ground.

For the study of the effect of radiation on the growth of northern white pine, seedlings 11 years old growing in 3 degrees of irradiation intensity were used. These seedlings had been established under a shelterwood; the 3 degrees of irradiation intensity were obtained by (1) a complete removal of the overwood giving complete "open" insolation, (2) a partial removal leaving a canopy estimated as 40%, and (3) leaving the overwood as after the first thinning, estimated as an 85% canopy. The relative leader growth of the seedlings in 1923 and the cumulative radiation intensities for 105 out of 125 days from May 12 to September 13, 1925, were as follows:

	85% canopy	40% canopy	Open
Relative Leader Growth	130	323	505
Gram-calories per square cm.	12,870	26,850	47,280
Ratio: $\frac{\text{Rel. Growth}}{\text{Radiation}} \times 100$	1.01	1.20	1.07

The leader growth is apparently proportional to radiation as measured by the thermopile used, up to the intensity of full sunlight. How far this iconoclastic result may be due to the neglect of the possible increase in available soil moisture because of the removal of root competition and/or the possible increase in rate of nitrogen liberation because of increased humus transformation of the higher soil temperatures cannot be stated.

In a study of synchronous data on relative humidity obtained at Petersham in the study of weather and fuel relationships (Pf, B-5) and the radiation study, it was found that the two could be correlated. Using all the data available, 172 3-hour periods in August and September 1927, a regression coefficient $r = -.76$ was obtained. The correlating equation is

$$S.\ R.\ (d = \pm 33.69) = 321.3 - 2.811\ R.\ H.$$

where S. R. is the solar radiation in gram calories per square centimeter for a 3-hour period, d is the standard error, and R. H. is the relative humidity in per cent at the end of the period. If the data are refined by using only the 11 a.m. to 2 p.m. periods and correcting the relative humidity record by the integrated deviation during that period as shown by the hair hygrograph, we have for 57 periods an $r = -.84$ and a correlating equation

$$S.\ R.\ (d = \pm 30.53) = 318.3 - 2.657\ R.\ H.$$

Relative humidity has been shown to be a valuable criterion in predicting fire hazard, presumably because it was an index of the saturation deficit of the atmosphere and the avidity with which it removes water from inflammable material. On the basis of the above data it would seem that relative humidity is valuable rather as an index to the intensity of solar radiation which vaporizes the water in exposed inflammable materials.

Progress for 1928

Considerable advance was made toward the perfection of the spherical thermopile as a precise radiometer. Aid was given to the Eppley Laboratory, Incorporated, in the choice, installation, and manipulation of the machinery for enclosing the thermopile in the glass bulls, as well as in the actual construction of the thermopile. Some effort was also spent in consultation on the enclosing of the Weather Bureau thermoelectric sunshine recorder, which is a plane thermopile designed by Professor Kimball and Mr. Hobbs. In turn the Eppley Laboratory permitted the use of their dark room and precision radiometric apparatus.

The calibration of the thermopiles has made it possible to give the radiation measurements of previous years in terms of absolute units, that is, heat units received on a unit of surface in a unit of time. The conversion of this data is practically completed.

The necessary revision of manuscript to include the improvements in design of the thermopile, the description of its characteristics, and the discussion of the relation of growth to the radiation intensities in terms of absolute values is practically completed.

The possibilities of the capacity method of determining soil moisture have been examined; the method is apparently without value for present purposes.

No progress was made in the investigation of the value of the capacity method for the determination of duff moisture.

The radiation studies were continued in the Adams Fay Block of the Harvard Forest. They were used for the study of the characteristics of the newer models of thermopiles, and for checking on the laboratory calibrations. The intergration of data is not compiled, and will not be unless occasion should arise for the data in the fire weather or other studies.

Publications and reports

Gast, P. R. Manual of radiometry for plant physiologists. Typewritten, 1000 pages. 3 tables. 1927.

_____ Insolation and silviculture with reference to studies on the Harvard Forest. Typewritten, 50 pages. 16 figures, including 3 graphs. Submitted as thesis to faculty of Bussey Institute, Harvard University. 1927. To be superseded by next item.

_____ A thermoelectric radiometer for silvical studies. To be published as a bulletin of the Harvard Forest. 50 pages. 18 figures, including 5 graphs.

_____ A normal incidence thermoelectric sunshine recorder. 2 pages. 3 figures, including 1 graph. To be submitted to Monthly Weather Review.

_____ A correlation between solar radiation and relative humidity. 2 pages. 5 tables. To be submitted to Monthly Weather Review.

_____ and Stickel, P. W. Solar radiation and relative humidity in relation to duff moisture and forest fire hazard. 2 pages. 1 graph, 1 table. To be submitted to Monthly Weather Review.

Plans

Complete the manuscripts on the above publications before May 1. Assist in planning any work which may be in prospect after that date to which this information may contribute.

Assignment

P. R. Gast, Northeastern Forest Experiment Station and Harvard Forest.

1929 Minor Project

TYPES

Project

Phenological observations of trees and shrubs in the Northeast (T-2).

Scope

To correlate phenological observations with certain natural phenomena considered as important operating factors in the studies being undertaken by the station.

Status

Flowering, fruiting, and leafing habits of trees can be definitely tied in to silvicultural and protective measures. Fire weather conditions, emergence of insects, fruiting of fungi, etc., may be correlated with certain stages in phenological processes. This project was added in 1928 at the request of the Washington office. Its success will depend on the cooperation that can be obtained.

Progress for 1928

Cooperation of this project was sought informally of a few individuals but with not too encouraging results.

Plans

It is planned to make a definite request for cooperation from various agencies in the collection of the data during the current year.

Assignment

Staff, Northeastern Forest Experiment Station, in cooperation with interested agencies throughout the Northeast.

MISCELLANEOUS PUBLICATIONS

Forest investigations under way in New England and New York. Mimeographed, 83 pages. April 1, 1924.

Supplement to forest investigations under way in New England and New York. Mimeographed, 32 pages. April 1, 1925.

New England places of interest to foresters. Mimeographed, 13 pages. June 5, 1924. (In cooperation with the New England Section, Society of American Foresters).

Behre, C. E. Preliminary yield tables for second growth western yellow pine in the Inland Empire. University of Idaho Bulletin, Vol. 23, No. 20. Forest Experiment Station Series 1, 19 pages, tables 3, 6 figures. 1928.

_____ Preliminary normal yield tables for second growth western yellow pine in northern Idaho and adjacent areas. Journal Agricultural Research 37:379-397. 8 tables, 12 figures. 1928.

Boyce, J. S. A possible alternate stage of Pucciniastrum myrtilli (Schum.) Arth. In Phytopathology 18(7):623-625. July, 1928

_____ A conspectus of needle rusts on balsam firs in North America. In Phytopathology 18(8):705-708. August, 1928.

_____ Lophodermium abietis on Pseudotsuga taxifolia. In Mycologia 20(5): 301-302. September-October, 1928.

_____ Deterioration of windthrown timber on the Olympic Peninsula, Wash. Typewritten, 47 pages, 11 figures, 1 plate, 18 tables. (To be published as United States Department of Agriculture, Technical Bulletin 104 and now in page proof).

_____ The future of forest parasites in the United States. Typewritten, 8 pages. December 26, 1928. (Accepted for publication in Journal of Forestry.)

Stickel, P. W. Physical characteristics and silvicultural importance of podsol soil. In Ecology 9:176-187, 7 figures, 6 tables. April, 1928.

_____ translation of Hesselman, H. Studier Över Barrträdsplantans Utveckling I Råhumus. I. Betydelsen Av Kvävemobiliseringen I Råhumustäcket För Tall- Och Granplantans Första Utveckling. (Studies of the development of coniferous plants in raw humus. I. The significance of the nitrogen mobilization in the raw humus layer for the early development of pine and spruce plants). Medd. f. Statens Skogsförsökasnstalt. Häfte 23. N.o. 6-7, 337-411. 1927. Translation of German rèsumè pages 412-432. Typewritten 26 pages. (To be mimeographed).

_____ translation of Melin, E.: Studier Över Barrträdsplantans Utveckling I Råhumus. II, Mykorrhizans Utbildning Hos Tallplantan I Olika Råhumusformer. (Studies of the development of coniferous plants in raw humus. II. The development of Mycorrhiza on pine seedlings in various forms of raw humus). Medd. f. Statens Skogsförsökanstalt, Häfte 23 N:o 6-7, 433-486. 1927. Translation of German resume pages 487-494. Typewritten 11 pages. (To be mimeographed).

_____ translation of Melin, E. Untersuchungen über die Bedeutung der Baummykorrhiza. Eine ökologischphysiologische Studie. (Investigations on the significance of tree mycorrhiza: An ecological-physiological study.) 1925. 152 pages. Jena:Gustaf Fisher. Being translated. Translation will be published by Edwards Brother, Ann Arbor, Michigan).

MISCELLANEOUS REPORTS

Gast, P. R. Program of proposed fundamental research on radiation, moisture and nitrogen relations. Typewritten, 21 pages. 1928.

FINANCES

Appropriation for silvicultural investigations.

The Experiment Station's allotment for the fiscal year 1930 beginning July 1, 1929 will be $27,000 to which will be added $1420 for salary increases under the Welch Act. This allotment will not permit any new projects to be undertaken and in fact is insufficient to finance current projects without assistance from cooperators.

Cooperative Funds

It has been possible to continue the study of weather and fuel relationships through the financial aid given by cooperators who made contributions for the season of 1928 as shown below:

Agency	Deposited with Forest Service	Disbursed by Agencies
Harvard Forest	$1000	
Maine Forest Service		$565
New York Conservation Department		385
Finch, Pruyn & Company		330
New York State College of Forestry		435
	$1000	$1715

Sufficient funds have been assured for the 1929 season so that this study can be continued.

A balance of about $800 remains of the cooperative fund for forest insect investigations in Maine. This money is being held to pay certain of Peirson's expenses and for assistance that he may employ.

The fund furnished for the white pine weevil study being handled by the Bureau of Entomology has been exhausted.

STATION PERSONNEL

Permanent

J. S. Boyce (Appointed March 1, 1928)	Director
M. Westveld	Associate Silviculturist
P. W. Stickel	Assistant Silviculturist
R. G. Wheaton (Resigned September 30, 1928)	Assistant Silviculturist
H. J. MacAloney (Bureau of Entomology)	Forest Entomologist
Perley Spaulding (Bureau of Plant Industry)	Senior Pathologist
J. B. Hansbrough (Bureau of Plant Industry)	Assistant Pathologist
P. R. Gast (In cooperation with the Harvard Forest)	Agent
W. B. Barrows	Computing Clerk
Mary E. Turrell	Senior Clerk
Rose M. Delaney (Resigned July 31, 1928)	Assistant Clerk
Kathryn E. O'Neil	Assistant Clerk

Temporary

L. S. Altpeter	K. A. Salman
R. A. Chapman	Walter Schaeffer
R. B. Craig	A. R. Spillers
Donald Curtis	L. H. Taylor
R. K. Daley	J. J. Truncer
A. W. Gottlieb	M. A. Westveld

NORTHEASTERN FOREST RESEARCH COUNCIL - 1929

Maine

G. T. Carlisle, Jr.	Consulting Forester
E. B. Draper	Timberland Owner

New Hampshire

W. R. Brown	President, New Hampshire Timberland Owners' Association
J. H. Foster	State Forester

Vermont

R. M. Ross	Commissioner of Forestry

Massachusetts

R. T. Fisher	Director, Harvard Forest
R. W. Thatcher	President, Massachusetts Agricultural College
E. H Thomson	President, Federal Land Bank

Connecticut

W. L. Slate, Jr.	Director, Connecticut Agricultural Experiment Station
J. W. Toumey	Professor of Silviculture, School of Forestry, Yale University

New York

R. S. Hosmer	Chairman, Department of Forestry, Cornell University
W. G. Howard	Superintendent, Division of Lands and Forests, Conservation Department
R. S. Kellogg	Secretary, News Print Service Bureau
F. F. Moon	Dean, New York State College of Forestry, Syracuse University
G. W. Sisson, Jr.	President, Racquette River Paper Company.